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11 — *Journal Section of the American Society of Heating and Ventilating Engineers*

Plan now to save heating steam next winter . . . see page 75

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THE EDITOR'S PAGES

OIL CAN'T HEAT ALL AMERICA

The oil industry is not running out of oil, but until pipe lines and other facilities are completed to make it possible for the Middle East to supply most of Europe's needs, the petroleum industry will not be able to take care of further increases in heating oil demand of anything like the magnitude of the increases met the past two winters, according to Robert E. Wilson, chairman of the board of Standard Oil Co. of Indiana, in an address last month before the Oil-Heat Institute. Natural gas, and especially coal, with reserves enormously greater than those of oil, will have to take up the bulk of any further increase in the home-heating load, he said. Barring strikes or catastrophes, the industry can be reasonably sure of its ability to produce, transport, and refine *7 or 8 percent* more petroleum for domestic use in 1948 than it did in 1947; while that may not sound like much of an increase, it means spending about $3,000,000,000 to expand every branch of the industry to handle nearly 400,000 barrels a day more crude and products, he said.

WEAR A V.F.W. "Buddy" Poppy MEMORIAL DAY

This does *not* mean that the petroleum industry will be able to take care of a further increase of 7 or 8 percent of new oil burners in 1948, according to Mr. Wilson. In the first place, at least 2 percent of that increase in oil supply is necessary to fill up tanks to offset the fact that stocks of heating and other products are at extremely low levels. If we are to avoid the local shortages that plagued us last winter, we must build up inventories and fill up the new pipe lines and terminals that are being built to help avoid future shortages, he stated.

In the second place, the remaining 5 percent will be necessary to take care of the new oil burners which were installed in the latter half of last year and did not use their full annual requirements in 1947 but will do so in 1948.

It may be asked whether the percentage increase in the amount of oil available for heating may not be greater than the estimated 7 or 8 percent increase in crude runs, as it was during recent years. That is a possibility, Mr. Wilson said, but the further increase cannot be large because industry yields of heating oils during the past year were very close to the practical maximum. Furthermore, military and other demands for other products, particularly gasoline, jet fuel, and diesel fuels, bid fair to show another substantial increase this year, and the users of these products will in effect be bidding for the available supplies of petroleum products.

WOOD FIBER BLANKET INSTITUTE ELECTS SAWTELL

At the recent annual meeting of the Wood Fiber Blanket Institute, R. B. Sawtell was re-elected president and J. D. Fischer was elected secretary-treasurer.

Mr. Sawtell is sales manager of the Kimsul division of Kimberly-Clark Corp. Mr. Fischer is manager of specialty products sales of the Wood Conversion Co.

URGES CLEAR AND CONCISE SPECS

Resistance to "the evil of rising prices" in the construction industry, through closer cooperation between engineers and contractors who can "eliminate nonessentials and fineries for appearance sake" and thus stretch the construction dollar as far as it will go, was urged at the spring meeting of the American Society of Civil Engineers.

Lower costs can be achieved through clear, concise specifications which give bidders foreknowledge of specifically what is to be required, rather than leave many items to the discretion of the engineer, D. W. Winkelman, president of the Associated General Contractors of America, Inc., told the construction division of the ASCE.

While he stated he felt his proposals for closer cooperation between the men who design works of construction and the men who build them are applicable in all branches of the construction industry, Mr. Winkelman particularly emphasized need for attention to the problem in the highway field.

VISE STANDARDS NOW AVAILABLE

A simplified practice recommendation for vises has been approved for promulgation, according to an announcement by the National Bureau of Standards. The recommendation is identified as R229-48, Vises (Machinists' and Related Kinds).

The recommendation is based on the industry's experience with mandatory simplification during the war. It covers machinists, combination pipe, filers or tool makers, sheet metal workers, heavy chipping, and steamfitters vises.

Until printed copies are available, mimeographed copies may be obtained without charge from the Commodity Standards Div., National Bureau of Standards, Washington 25, D. C.

SEES 500,000 OIL BURNERS THIS YEAR

There will be enough additional fuel oil this year to adequately supply 10 percent more power driven oil burner installations than those at present in use, according to R. S. Bohn, president of the Oil-Heat Institute of America, at the opening of the National Oil Heat Exposition in Chicago last month.

On the basis of a factual survey recently completed on the capacities of the petroleum industry, approximately 350,000 more power driven oil burners than the 3,500,000 now in use can be installed this year without overtaxing oil supplies, he said. This number, together with an estimated 150,000 burners for replacement of equipment now obsolete, would give an industry total of 500,000 oil burners this year. It is also estimated that about 650,000 additional space heaters can be installed. Space heater manufacturers estimate that they can sell 350,000 replacement units to bring the total sales of space heaters for the year to 1,000,000.

Mr. Bohn pointed out that replacement of inefficient power driven and space heating equipment would increase oil availability.

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THE EDITOR'S PAGES

RELEASES MOVIE ON STAINLESS STEEL

Use of oxygen and other modern techniques of electric furnace production of stainless steel is brought to the screen in color in a motion picture released by the Allegheny Ludlum Steel Corp. Titled Melting and Refining of Modern Steels, the 16 mm movie was shot at the company's Brackenridge, Pa., plant and is a start-to-finish story of stainless steel as it is melted in an ultra-modern 50 ton electric furnace.

Designed for technical groups, this instructive and entertaining 20 minute film may be obtained for free showings on request to the company's headquarters in Pittsburgh.

AND NOW—THE SNOW MELTING MARQUEE

Installation of a "heated pavement" in front of the new six story Peoples Savings Bank building at Providence, R. I., will insure snow- and ice-free sidewalks for customers and passersby next winter without the use of shovels or chemicals. Hot water flowing through a network of wrought iron pipe is designed to warm the sidewalk concrete, in which it was embedded, so that snow melts and ice is prevented from forming. Residual water drains into the gutter.

Besides the sidewalk system, the building has snow melting lines in the marquee. The marquee pipes are embedded in a 6 in. concrete slab that is topped by roofing and is plastered underneath with California stucco. Plans also call for the installation of similar pipes on the roof.

Objective of the overhead systems is to eliminate the hazard of snow or water falling on the heads of passersby. The new building is expected to be occupied in June.

MATHEMATICS BY SYNTHESIS

A calculating machine "based on a new approach to mathematics" and designed to solve difficult problems in the fields of electrical circuits, machinery, applied mechanics, hydraulics, and heat flow has been built by Westinghouse Electric Corp. and installed in a new laboratory at East Pittsburgh, Pa.

Called the "Anacom," the new analyzer solves problems by attacking them from a radically different angle. Instead of solving equations according to the rules of formal mathematics, the essential elements of the problem to be analyzed are synthesized from an array of electrical devices such as capacitors, resistors, and inductance coils.

Forces applied to a real machine —like short circuits, impacts, application of heat, or whatever constitutes the actual problem—are represented by electrical voltages or currents that can be applied to the synthetic machine set up on the computer at the same places where the actual forces occur. The resulting voltages—representing stress, motions, temperatures, and the like —can be measured accurately at any point by merely connecting the leads of a cathode-ray oscilloscope to the analogous parts of the synthetic machine. A trace on the oscilloscope screen is an exact replica of the magnitude and wave shape of the corresponding quantity in the actual machine.

L. C. REED HEADS PFMA

At the ninth annual meeting, held recently at Daytona Beach, Florida, the Propeller Fan Manufacturers' Association elected Lyman C. Reed president, W. J. Lohman, Jr., vice president, and L. O. Monroe secretary-treasurer.

Mr. Reed is president of Reed Unit-Fans, Inc., and Mr. Lohman is an official of Chelsea Products, Inc. Address of the PFMA is 5-208 General Motors Bldg., Detroit 2.

REVAMP EDUCATION, SAYS CARNEGIE HEAD

Declaring that the American educational system has produced men with "admirable intellectual power in establishing the physical and biological sciences" but has failed to make man capable of coping with "human, social and economic problems . . . in a civilized manner," Dr. Robert E. Doherty, president of the Carnegie Institute of Technology, called for a general revamping of education, in a recent speech at St. Louis before the Engineer's Club and the local chapter of the American Institute of Architects.

Dr. Doherty stated that our educational system must do more to "establish the essential basis for civilized action on the human and social side" of life.

In calling for a revamped education which would "cultivate a philosophy of national life and individual life that is essential to an enduring free society," the Carnegie president urged special attention be given professional education, since, he explained, a nation's "professional men set the pattern of national life."

Turning to his own field of professional education, Dr. Doherty outlined the program in engineering education initiated at CIT in 1938, and offered it as one example of an approach to the problem of professional education to make it capable of meeting the demands of present-day society. This program, as explained by Dr. Doherty, is aimed at: developing in the student a thorough understanding of and the ability to use the professional method of thought, and the ability and desire to learn from professional experience; and developing in the student the ability and desire to deal with whole problems—that is, to consider the human-social as well as the technical elements of all problems.

"The hope that the comparative freedom of the American people may endure does not lie alone in public orations, congressional debates, and popular suffrage; these are merely the manifestations of that freedom," Dr. Doherty concluded. "It lies in the ultimate attainment in public affairs of scholarly and professional thought, pursued under the discipline of the scientific spirit, and motivated by a philosophy of public good. Further, it lies in the cultivation of abilities and attitudes during professional study that will make possible attainment of these essential qualifications, and therefore lies finally in the proposal that professional education recognize its great opportunity and responsibility and provide programs that will accomplish the purpose," he said.

Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

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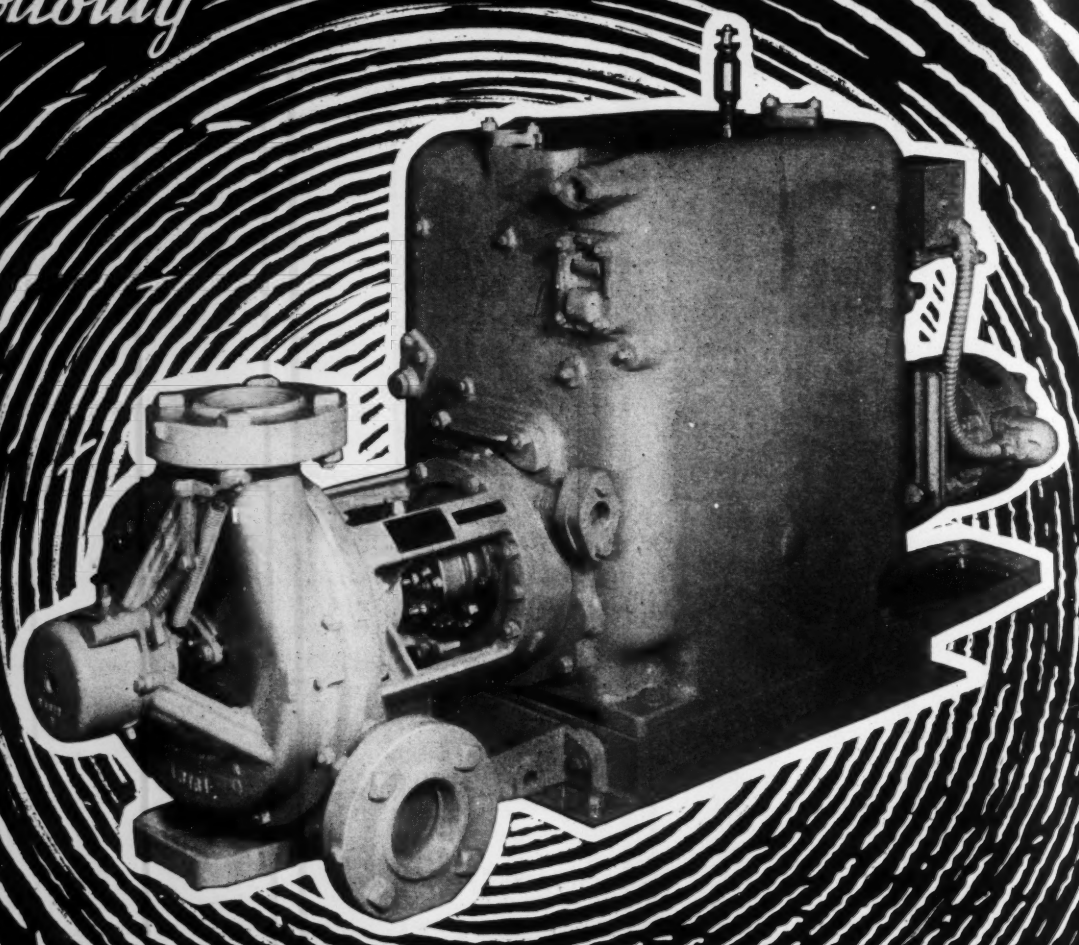
Centralized Heating Economy



A RETURN LINE VACUUM PUMP THAT CUTS HEATING COST.

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Simple, compact, one moving element, no wearing parts, no internal lubrication. Bulletin No. 203 gives the facts. Your copy is waiting.

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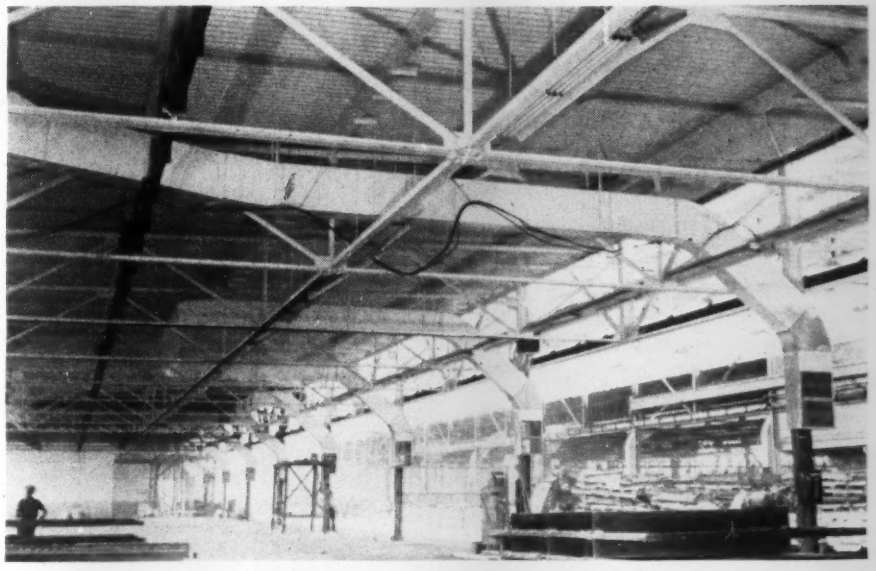

The ventilating installation comprises 10 independently controlled mechanical supply duct systems which discharge air at the building columns through outlets 8 ft above the floor level.

Individual Supply Duct Units Heat and Ventilate New Plant

TEN independently controlled mechanical supply duct systems discharging air through outlets 8 ft above floor level at the building columns ventilate and heat the new Ashtabula plant of the Reliance Electric & Engineering Co. Following wartime naval practice, the axial flow fans and their driving motors are installed inside the ducts. Natural exhaust is through eight 66 in. diameter roof ventilators. Two oil fired package unit boilers furnish steam for plant heating, and unit heaters are installed for heating in loading dock areas

COMPACTNESS OF layout, high operating efficiency with minimum interruption in service, ease of maintenance, and full availability of floor area for manufacturing purposes—these are said to be the features of the forced air system installed by the Reliance Electric & Engineering Co. to heat and ventilate its new Ashtabula, Ohio, plant where 1 to 20 hp a-c and d-c motors are now being turned out in volume. The plant, 480 ft long and 250 ft wide, contains a production area of 120,000 sq ft, a considerable portion of it conveyorized in the interest of high speed, straight line production.

The ventilating system is specially designed to move as much as 18,000,000 cfh of air through the building, a sufficient volume to keep the plant interior under a slight positive pressure at all times, thereby minimizing dirt infiltration. This system provides six complete changes of filtered air per hour during summer operation, and three complete changes per hour of tempered air for winter conditions.

The ventilating installation consists of 10 independently controlled mechanical supply duct systems with air discharged at each building column through outlets located at a height of 8 ft from the floor, to afford uniform air distribution throughout the building. Therefore, all areas are adequately supplied with air volumes at desirable velocities necessary to provide comfortable air conditions within the working areas of the building.

Natural exhaust is effected through eight 66 in. diameter, gravity type roof ventilators equipped with pneumatically controlled louver dampers.

The entire system operates against a pressure of 1½ in. water gage, found to be sufficient to counteract infiltration of dirt.

Flexibility of control to maintain service on an uninterrupted basis was the first consideration. The second was to keep the duct work necessary to as simple an arrangement as possible.

Both conditions have been realized in the scheme of 10 independently controlled sections which was adopted. Interruption in the operation of one of them does not necessarily interfere with the functioning of the others to carry the heat-

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ing and ventilating load of the plant. Use of several self-contained duct systems has kept the size of the duct work down, eliminating elaborate and possibly cumbersome feeder installations to get the desired volume of air to all parts of the plant.

Exclusive of the downcomer ducts, the rest of the duct work has been installed "upstairs"—between the bottom chord of the roof trusses and the roof proper—where it is out of the way, but readily accessible for inspection and maintenance.

Each of the separate systems heats an area 80 ft by 125 ft through six discharge points. Downcomers closest to the wall distribute air to areas roughly 25 ft by 40 ft, while downcomers on interior building columns supply areas approximately 40 ft by 50 ft. Outlets on opposite walls of the plant are faced in opposite directions to maintain a continually circulating movement of air within the general manufacturing area.

Summer Conditioning Can Be Added

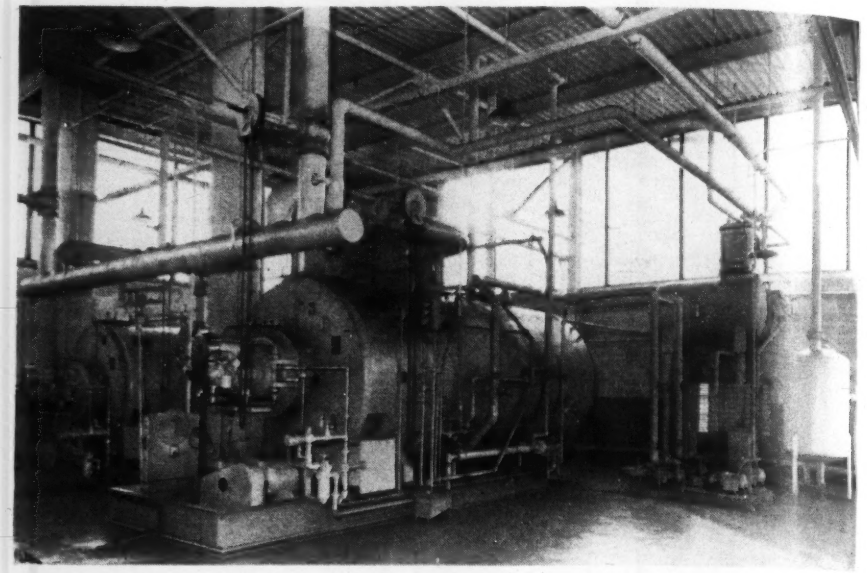
Each duct system has its own air inlet, equipped with weather-resistant louvers, located in the sash just below the roof line. Air from each is fed into a plenum chamber equipped with filters of the washable viscous type and which are removable for cleaning and recoating. As it is filtered, the air enters a second plenum chamber where ample space has been provided for the placement of cooling coils should summer air conditioning subsequently be wanted in any part of the plant.

From the second plenum chamber, air can be drawn into either of two fans. One fan operates the year 'round; the other is used only during the summer months. For winter heating, the air is carried over steam coils, each of 451,000 Btu capacity, converging into a single duct from which branch the downcomers. Dampers located throughout the duct network balance the flow of air at each downcomer.

Plenum chambers, steam coils, and fans are all mounted on a platform to make them easily accessible for inspection.

Fans and Motors Are Inside the Ducts

Compactness of layout and efficiency of operation are achieved through the use of axial flow fans which are mounted, complete with single speed motors of a special type, inside the ducts in an arrangement patterned after wartime installations aboard naval vessels.

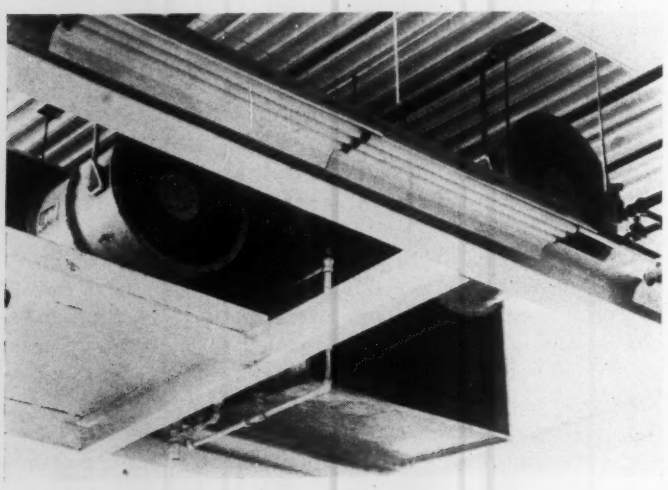


Steam for heating is supplied by two oil fired package boiler units. Underground fuel storage tanks near a rail siding provide capacity for six weeks' operation

Steam for main plant heating is supplied by two oil fired package unit boilers of 200 and 300 hp respectively. Steam mains are sized to handle steam at 50 lb, which is cut to 5 lb at each heating unit by pressure reducing valves. Underground fuel storage tanks, conveniently located near a rail siding, provide capacity sufficient for about six weeks' operation. Blower type steam unit heaters of large capacity furnish supplementary heat in loading dock areas.

A 75 hp, vertical, low speed air compressor is located in the boiler room, from which a complete system of compressed air piping serves all areas of the plant. Piping services for compressed air, gas, water, steam, condensate return—and the ventilating ducts—are all carried in the roof trusses of the building. Frequent use of plug tees in the piping systems facilitates making future take-offs.

R. C. Grow, Reliance process engineer, supervised the entire project, and George B. McClellan, also of the Reliance engineering staff, was in charge of plant construction on the site. Arthur E. Rowe and Associates, architectural-structural engineers of Cleveland, were the consulting engineers. Paul C. Mehnert of Cleveland was consulting electrical engineer. Gran Bros. of Ashtabula were the general contractors.



The axial flow fans and their motors are inside the ducts in an arrangement similar to that used on wartime installations aboard naval vessels

WILLIAM B. PRIDE, plant engineering dept., Boeing Airplane Co., Seattle, has had a lot of experience in fuel economy and steam conservation work. He describes here tried and proved methods used by Boeing and a large group of Seattle's modern office buildings to simplify and assure fuel economy. Management as well as operating men will find this article interesting and informative

HERE'S HOW to Save

HEATING STEAM

ADVANTAGES OF daily records of steam consumption for plant and building heating were stressed in the first part of my article in the April HPAC, and three charts for three successive months, showing steam consumption for a cafeteria building, were reproduced.

Causes of Variation in Steam Use

The one and most important figure resulting from these daily records is the pounds of comfort heating steam consumed per degree-day per thousand cubic feet of building space. Theoretically, once this figure has been established, it should remain constant and would show up on our graph as a straight line; with good operation and control it will actually plot out to be reasonably straight under most operating conditions. There will be times when humps and dips will appear in this curve, cause for which might be one or more of the following:

1) When we are operating under outside temperature conditions that place minimum demands upon our heating system, such as 5 degree-days, we can expect a hump in our curve, as the efficiency of our heating system drops decidedly under minimum load conditions. In fact, we will at times have temporary heating loads when we actually show zero degree-days during such times as we may need a little heat in the morning and yet our daily mean will average out to 65 F or over. We will also have local conditions within the heated space, where certain occupants will open windows during these borderline periods when we have a small amount of heat in the system. This obviously promotes heat loss.

2) With wind velocities of 15 mph and higher, we can expect a hump in our curve, as the normally small infiltration losses become much larger and we then have an extra heat demand which is not accounted for in our degree-day curve; consequently, this should be noted on the daily record for future reference. Some utility companies add one degree-day for each 5 mph of wind velocity. I have not used this method. However, it is probably a good figure to use and would eliminate one of the questionable factors in our curve.

3) During extreme minimum outside temperatures, when we may be operating at outside temperatures bordering on or below actual design conditions, and in some cases are not able to quite maintain proper inside comfort heating conditions, we shall probably find that our curve will show a favorable dip, which must be properly interpreted and not set as a future possible goal by which to operate. Longer than normal hours of occupancy, days following a shutdown due to holidays or other reasons, will cause a slight hump in the curve. Experience and use of the curve will soon clear up and explain these abnormal conditions.

What Are the Right Heating Hours?

Another point we might briefly touch on in this fuel economy discussion is the matter of necessary hours of heating. There seem to be two definite schools of thought on this subject, each of which has its points.

Some operating engineers believe that it is cheaper to maintain some heat for 24 hours of the day, while others feel that it is more economical to shut down at night or during hours of normal non-occupancy. I am of the opinion that local conditions and experience will determine which method to use.

I have done considerable checking both ways and am of the opinion that in the Puget Sound area on the west coast, it is definitely

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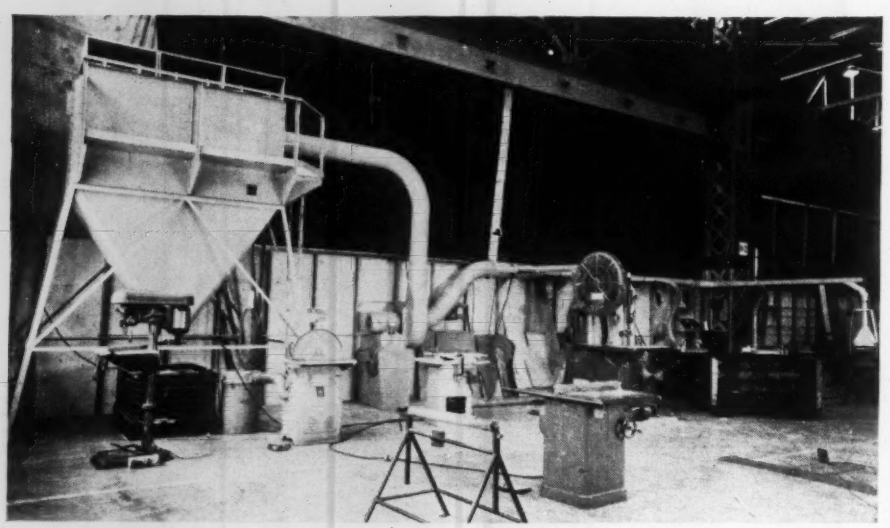

Prior to shakedown, the draft gage on this installation for reclaiming exhaust air may read anywhere up to 3 in. water gage. After shakedown, the resistance drops considerably. When the draft gage finally will not shake down below 3 in., the filter media are renewed. Note the plexiglass peep-hole directly under the catwalk; this serves a dual purpose—it is excellent for observing the action that takes place within the unit, and it is a positive check to insure the hopper will not get too full before being emptied. It will be noticed that the entire installation is designed and installed with provisions for moving and relocating with minimum expenditure; this is important in the Boeing plant, due to the ever-changing operations and new machinery

economical to cut the heat off during most of the hours of non-occupancy with the exception of about an average of one week a year, when we have our minimum outside temperatures and during which times we maintain only a small portion of the normal heat during hours of non-occupancy. In this connection, I refer only to office buildings of first class construction and a well constructed industrial plant when heating for an occupancy of one shift. (When operating under conditions of occupancy for more than one shift, other necessary heating hours should be determined).

Some of the problems the operator will be confronted with when operating under a schedule and trying to curtail unnecessary steam consumption are:

1) *Complaints of insufficient heat the first thing in the morning.* Investigation may disclose that some of the windows were left open during the night, or some of the convectors or radiators may have been shut off until the occupants' arrival. Such conditions are generally the fault of the occupants themselves and have been created on the previous day. We have found that we can eliminate most of this trouble by informing the occupants with printed notices, letting them know it is for their comfort to see that all windows are closed and convectors left on before leaving the building. In addition to this, it may be necessary to have the night janitor department check all windows and convector valves. During the operating day and hours of occupancy, the steam control operating personnel should constantly be on the alert in observing the position of windows. A large amount of useful heat can thus be saved or wasted. It appears to be habit for some occupants to open a window rather than throttle their individual steam control.

2) *Complaints from some locations of insufficient heat*, especially when operating the system under minimum demand conditions (which may mean minimum steam pressures, or considerable time elapse between on and off cycles when using intermittent control). Make a brief check of a number of locations on the system to determine whether the condition is localized or general. If the trouble is localized, take steps to locate and eliminate it.

3) *Complaints of over-heating in some spots.* This type of complaint is rather unusual; although the condition may often exist, it should be one of the duties of the operating personnel to locate and eliminate the cause. This problem would usually tie in with Problem No. 2, which would indicate that we probably have localized cold spots, and in order to bring these cold zones up to comfort temperatures we must overheat a large portion of the building.

Problems No. 1 and No. 2 are very common conditions on most heating systems that have been installed for some time, and they may go on for years wasting large quantities of steam unless the operating personnel are constantly checking and on the alert for such conditions. We will not enumerate on the many—and often minor—possible causes for these problems, some of which may be trapped feed or returns; partially plugged pipes, valves, orifices, radiators, or traps; water-logged lines, etc. *This is a very important phase of our steam saving program.*

Instruments Help to Save Steam

Before proceeding further, the subject of instrumentation (some of which is necessary in order to set up and maintain an intelligent operating schedule) should be mentioned. Instrumentation, from my personal experience, is a profitable investment. It greatly helps the operator in becoming completely familiar with the operation of his heating system, and stimulates a personal interest which improves operating efficiency with a resultant fuel saving. The size of the operation under consideration will determine the permissible instrumentation. I will not attempt to discuss the elaborate and extensive remote graphic instrumentation (which we all dream of) where the plant engineer can sit at his desk and see what is happening over the entire systems of light, heat, power, air, gas, water, etc.

We use standard indoor type thermometers, which may run from 20 to 120 F. These we hang permanently in typical locations in several rooms of the building and we check them several times during the heating day, thereby determining our operating procedure. We have portable graphic thermo-humidigraphs, on which we can set a 24 hr or a seven day chart and thereby analyze complaints or other conditions we desire to know more about.

We also use portable graphic thermometers on which we can set a 24 hr or seven day chart. We have found that the type with a few feet of capillary tubing is more flexible for most cases, and especially when we cannot conveniently locate our instrument exactly where we wish to check the temperatures. This capillary tube is also very useful for inserting in ducts, behind radiator grilles, in warm air outlets, and in other inaccessible locations.

We find that a higher range portable graphic instrument with a capillary tube and immersion bulb is most convenient for checking water or steam temperatures. This is largely an analysis or trouble-shooting instrument, but is nevertheless a good operating tool.

We have set up one of our seven day graphic temperature instruments with a few feet of capillary tubing and with the bulb located outside (north exposure with the bulb shielded from the direct sun rays). This records outside temperatures and is necessary knowledge in steam control operation. We also carry a small pocket sling psychrometer, which is most helpful in making spot checks; though in most cases we have no control over relative humidity. We are, however, interested in the wet and dry bulb readings when thinking in terms of the ASHVE comfort chart, which takes into consideration relative humidity and air motion in addition to dry bulb temperature. We use a pocket model maximum reading thermometer, scale 0 to 220 F, which is very useful in checking maximum temperatures in both comfort heating and domestic hot water.

We must at all times remember that the human body is a very poor thermometer, and while experience may help considerably in "guesstimating" the temperature, we will find on many occasions that we are way off the beam. When we have available graphic instruments, we should keep them in use at all times. While they are sometimes dubbed "stool pigeons," they are really silent watchmen, working for an insignificant salary, 24 hr a day, grinding out a lot of good answers —especially during hours of non-occupancy. These answers enable us to set up an operating procedure schedule that is most economical. There are other instruments that we use profitably, which probably could not be as readily justified for a small commercial or industrial operation. Among these is our graphic pressure instrument, which we think quite important for checking pressures with regard to steam flow and back pressures on returns.

Setting Up an Operating Schedule

Let us assume that a steam economy program is being set up in a building (or a group of buildings) which has been operating with no particular care or attention to fuel conservation.

We must first determine the approximate hours that heating is necessary, which will depend largely upon the normal hours of occupancy of the building. We know that the building should be up to comfort conditions by the time the occupants arrive, and we also know that we must maintain comfort conditions throughout the hours of occupancy.

I have used—with good results—empirical methods to determine the approximate times we must commence our heating-up period, which vary primarily with varying outside temperatures, wind velocities over 15 mph, building construction and occupancy, and the type and the condition of the heating system. These empirical methods are tentatively arrived at by the use of graphic thermometers.

In the average size building we should have at least two graphic thermometers. We would record outside temperatures with one instrument, and the other we would locate within the building, in what we assume to be an average location with respect to heating facilities, exposure, etc. We then experiment with our "turning on" and "turning off" time and note the resultant temperatures on our indoor instrument.

We are primarily concerned with bringing the space to be heated up to (or very close to) comfort temperatures by the time the first occupants arrive, and secondly, we must maintain these comfort temperatures until they leave. The value of our graphic thermometers is very apparent and they should be used continuously, to give us at all times a clear picture of our operating results.

We now have the necessary data to set up an operating schedule for varied conditions. Such a schedule, when complete, should suffice for the entire season and with the exception of physical changes, this schedule will be maintained from season to season. As an example for an outside temperature of 37 F, the operating schedule might read as follows: "Outside temperature, 35 to 40 F:

5:00 a.m.

(1) Open valve #10V.

(2) Start up vacuum pump with switch #10S.

(3) Check steam pressure at reducing valve. (Should read about 2 lb). Reset reducing valve if necessary.

7:00 a.m.

(4) Check thermometer in Room 211. Should read about 65. If below 65, increase steam pressure to 5 lb."

Obviously, a separate operating schedule would be drawn up for each building. In most cases it would be considerably longer than the schedule noted above, as it would clearly indicate approximately what time each operation should be performed under the entire range of outside and inside temperature conditions. From this schedule, the operator would determine:

1) Turning on time.

2) Necessary daily follow-up and operating procedure.

3) Turning off time.

If the control operator is going to handle a number of buildings, we must set up a definite timed route, the alternate being to allow sufficient time differential in our schedules to permit him to meet all instructions within the scheduled times. A copy of this operating schedule should be set up in a permanent manner in the mechanical room of each building. While such a scheduled procedure may at first sight appear rather complex, it is surprising how rapidly the operator familiarizes himself with it and thereby memorizes the instructions.

Identify the Valves and Controls

It is also most advisable to identify clearly (we at Boeing use per-

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manent stamped metal tags) all valves, switches, thermostats, and other controls necessary for the operation of the heating system. We include on the bottom of our operating schedule a complete list of these valves, switches, etc., and also clearly identify their locations. We then set up our operating schedule, as previously noted, complete to the last detail.

With proper thought and simplicity, this operating procedure schedule can be drafted in such a manner as to be readily interpreted by anyone with very little previous coaching. We also tie in our maintenance servicing schedules on traps, fans, etc., so that there is complete coordination between the service man and the operating personnel. This is most essential to insure, as much as possible, the continuous operation of all equipment when needed. The entire system is quite easy to control, since it all comes under the jurisdiction of the plant engineer.

This operating schedule and positive identification of controls pays very definite dividends, which we unfortunately cannot evaluate in dollars and cents. However, the advantages are apparent. We are able to eliminate (as much as possible) the chance of the heating system not being turned on or off in the event of an unforeseen accident or sickness of the regular operating staff. The problem of labor turnover does not give us the usual jitters, because our simplified system enables supervision to educate new personnel in record time and thus the supervisory personnel can devote their efforts more profitably to other problems.

Before terminating this operating procedure setup, let us not forget that a complete and frequent review of it is necessary in order to maintain a completely up-to-date schedule. The frequency of these reviews will depend upon the alterations of the physical system which may take place from time to time, and with other variables.

Several Ways Steam Is Saved

We equip all of our major steam traps and drip points with a test cock on the discharge side of the trap. Into this test cock we install (when testing) a simple pressure gage reading in psig; and in most cases we learn, without further check, the operating condition of the trap while working under actual conditions. Maintenance of steam traps plays a most important part in our fuel economy program.

Insulation is another important phase of economical operation. The value of and savings from effective insulation, with regard to the structure being heated as well as the steam piping and equipment, are generally well known. The insulation manufacturers have done a very good job in compiling and distributing complete data on the subject.

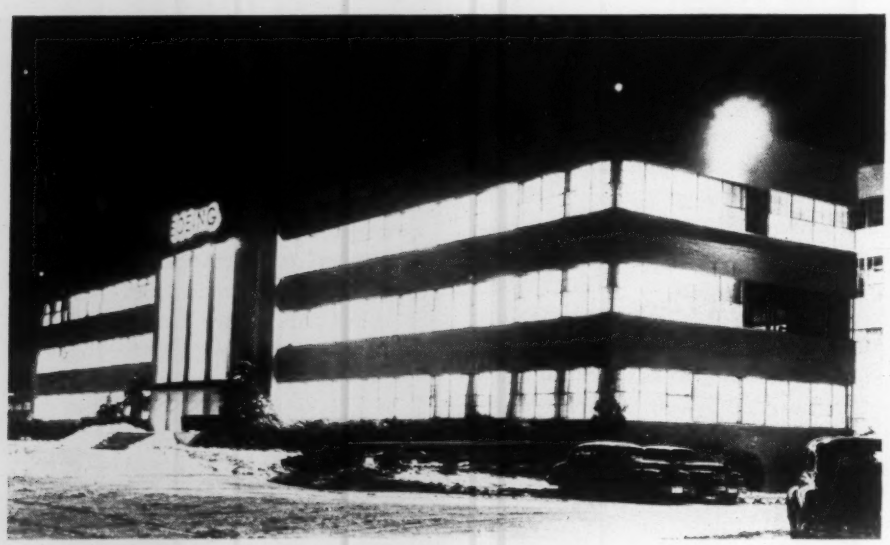
There are many economy measures which can be effected, which are sometimes more apparent to the field engineer than the designing engineer. This was especially the case during our tremendous "overnight" expansion prior to and during World War II. We must admit that fuel economy (in spite of our shortages) was probably of secondary importance at that time, with machinery and equipment ranking first. Many of our plants and structures were designed and built for the duration only. However, we now have to live with some of these war babies, and we must therefore strive to bring them up to efficient operating standards as rapidly as possible, based on the assumption that we are now operating on a competitive basis.

For example, it is not unusual—especially in factory areas with high ceilings—to find both volume and unit heaters mounted in such manner and location as to be discharging most of their output considerably above the area of occupancy. This means that we must carry excessive temperatures above the area of human occupancy in order to maintain comfort conditions within the working area. This condition is most apparent when using high pressure steam for heating. In many cases these units have not been designed for, and do not have sufficient throw, to accomplish the desired results from such an elevation. We should, therefore, install them at an elevation within their coverage, or replace them with units designed with sufficient range to deliver the heated air within the area of occupancy.

Power rates are quite low in our particular area; consequently, we use a large number of portable electric heaters to meet the needs of some unusual or temporary heating problems. We have found that we can use to advantage a new type of electric radiant panel. These panel heaters consume approximately 175 watts and consequently will amortize their original costs by savings in electrical energy, in less than one year, based on reduced electrical consumption only.

This panel might be described as a hinged metal sandwich. From outside appearances, the panel is composed of two sections, each section being approximately 2 ft square, and fastened together with a full length piano type hinge, the complete panel when fully opened

The Boeing administration building at night during, says the author, "one of those rare periods in Seattle when we had snow." Snow is such an oddity, he says, "that we have talked of using cooling coils to hold it for awhile when we do get it."



being about 4 ft long and 2 ft wide. The panels are surfaced with sheet aluminum and are about 1 in. thick (the radiant cable and insulation being contained within the sandwich). There is a single duplex asbestos insulated cord to plug them into a convenient outlet. Since these units were designed for constant operation, we have no switch or thermostat on them, which saves on maintenance costs. These panels were designed to be located in the well of a desk; being hinged in the center, there are several possible methods of arranging them. The surface of the "hot side" of the panel reaches a maximum temperature of 126 F, which eliminates any hazard from burns should any portion of the human body come in contact with them. We have found these units to be most satisfactory and preferred by the occupants concerned to the conventional, higher current consuming, units.

In a large industrial operation (like Boeing), there is a great deal of air constantly being removed by the various exhaust systems serving woodworking machinery, grinders, and removing excess heat from drying processes, etc. Most of this air has to be brought up to comfort temperatures before being exhausted; in many cases, it is nontoxic and harmless but is removing some solid waste particles. In such cases, we take this air, deposit the airborne particles in a cyclone or other settling chamber, run the air through a secondary dust arrester, and then return it to the factory areas without having to reheat it.

How to Heat A Big Tent

When the International Harvester Co. put up three huge tents in connection with its exhibition some months ago marking the 100th anniversary of the company's operations in Chicago, John M. Hannon, supervisor of the display, was confronted by the problem of how to keep the tents comfortable for visitors.

There was uncertainty about what the weather would be during the two-week exhibition of motor trucks, farm tractors and equipment, and industrial tractors and engines, on the windswept shore of Lake Michigan. The problem was twofold—how to ventilate the tents in case of warm weather, and how to heat them in the event of chilly weather.

The tents covered floor areas of 16,000, 18,400, and 22,000 sq ft, respectively. Each had 10 ft sidewalls and was 35 ft high in the center. They were pitched over concrete floors.

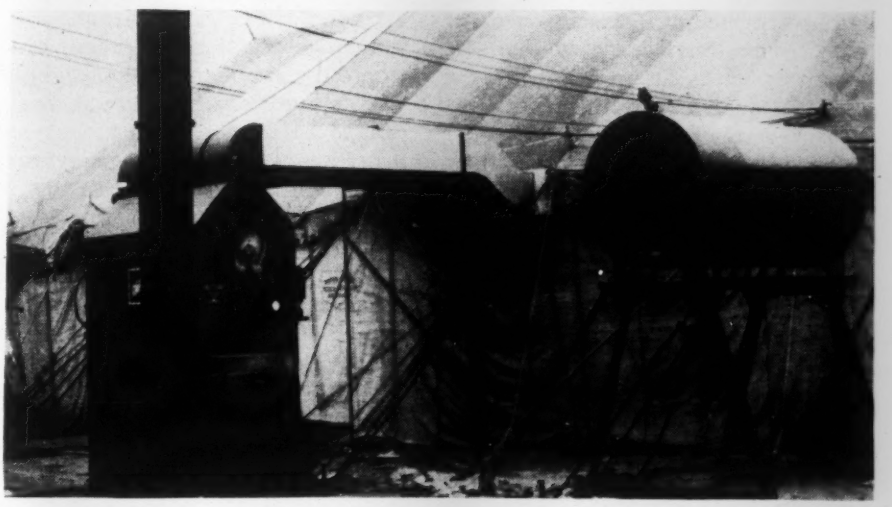
Three direct fired, warm air industrial space heaters, each having a capacity of 1,000,000 Btu per hr, were purchased. One heater was positioned outside each tent and a sheet metal manifold was connected to the four discharge nozzles on the top of the unit. A portable fuel oil tank was erected a few feet away from each heater. A 15 ft vent stack was installed. Those were the only connections required, besides the electric power lines. A duct was run from the heater through the canvas sidewall of the tent, and was wrapped in asbestos sheathing. Inside the tent, the duct was divided into two sections to discharge into the areas on both sides of a canvas partition.

As expected, two kinds of weather were encountered during the exhibition. The first week, outside temperatures were high and the heaters were operated only as ventilators. Fresh air, drawn into the base of the heaters, was discharged into the tents above head level and established comfortable conditions by serving as air circulators.

During the last week, however, the weather turned damp and cold. The oil burners then were ignited and warm air was discharged into the tents. Furthermore, it was fresh air because all of it was taken from the outside. Drawn into the base of the heater, the air swept over the stainless steel combustion chamber and then was discharged into the tent. This is similar to the installation of such heaters in foundries and other plants where fumes and dust necessitate continuous replacement of the air. The rapid velocity of discharge prevents excessive amounts of heated air from rising to the roof of the tent and establishes a "comfort zone" where the heat is needed.

The several days of inclement weather during the exhibit posed a test for the physical construction of the heaters, which were entirely unprotected. All exposed parts were subjected to driving rain and high winds but it was reported that the heaters stood up well under these conditions. International Harvester plans to use them in similar manner for future "temporary heating" needs.

Direct fired heater and fuel oil tank for heating exhibit tent on cold days, ventilating it on warm days



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MIDWEST POWER CONFERENCE

[Excerpts From Some of the Papers Given of Particular Interest to HPAC Readers]

EXCERPTS FROM some of the papers presented at the 10th annual Midwest Power Conference which are thought to be of particular interest to HPAC's readers are given here. The conference, held last month in Chicago, was sponsored as usual by the Illinois Institute of Technology with the cooperation of nine universities or colleges, the local sections of six national engineering societies, the Western Society of Engineers, the Engineers' Society of Milwaukee, and the National Association of Power Engineers.

The conference director was Stanton E. Winston, of Illinois Tech. A copy of the complete published proceedings for the affair will be mailed later on in the year to all those registered at the conference.

Evaporative Condensers Conserve Cooling Water

IN RECENT YEARS many communities have found that their present water systems are not sufficiently large to satisfy the increasing demands being made by domestic and industrial users. The reasons for such shortages are primarily either (1) inadequate purification and distribution systems, (2) inadequate sanitary and storm sewer disposal systems, or (3) an inadequate source of water.

S. C. Moucher (in a recent survey of city water supply systems published in Refrigerating Engineering, vol. 55, no. 2) found that of 56 major cities surveyed, 20 cities indicated that the problem of water supply for air conditioning has been a cause for study, and that restrictive measures in the future are likely. The details of a study made by the city of Chicago in 1936 were also summarized by Moucher and indicated that the Loop area alone would require 300 million gal per day if it were 100 percent air conditioned and no water conservation devices were installed.

Since water for air conditioning is needed for relatively short periods of the year, any large increase in water handling equipment for this purpose represents a large investment in relation to the return and indicates the desirability of water conservation equipment even where the supply of water is ample. In communities where actual shortages of water sources exist, the need for employing water conservation equipment to protect the health and safety of the community is self-evident.

When water is used as a cooling medium on a "once-through" basis and then thrown to waste each pound will remove from 15 to 30 Btu from the system, depending upon the conditions of operation. When, however, the water is recirculated and recooled by evaporative cooling, each pound evaporated is capable of removing approximately 1000 Btu from the system. This fact indicates the desirability of evaporative cooling as a means of conserving water.

Water may be recooled by evaporation in one of the following systems: (1) Spray pond. (2) Atmospheric cooling tower. (3) Forced draft cooling tower. (4) Induced draft cooling tower. Water that has been recooled in one of the above pieces of equipment may then be recirculated through the heat exchanger, or condenser, and perform its function of removing heat from the system.

In 1929-1930, the railroads became interested in a wetted surface condenser to reduce the weight and size of the air cooled units then used for passenger car air conditioning. The unit, of course, also had to be portable and require a limited amount of water. Largely because of this need, the industry developed an evaporative type condenser. The evaporative condenser makes use of the same principle of heat removal by evaporation as the cooling tower or spray pond, but combines the function of the tower and the condenser into one compact piece of equipment.

The units are factory constructed into sections that can be easily assembled on the job. Sizes are available from 3 to 100 tons, and larger systems can be accommodated by the use of multiple units. When the unit is located indoors, it may help provide ventilation for the building by drawing its air directly from the space. Provisions should be made however, for air to be taken from outdoors during the heating season because of better performance with

colder outdoor air and, also to avoid loss of heated air from the building.

In the unit [shown by the speaker] the air first travels through the main condensing section and then over a dry coil where it serves to remove the superheat from the high temperature refrigerant gases. It is then drawn into the fan and rejected to the atmosphere through duct work, if necessary.

Desuperheating Section Has Dual Function

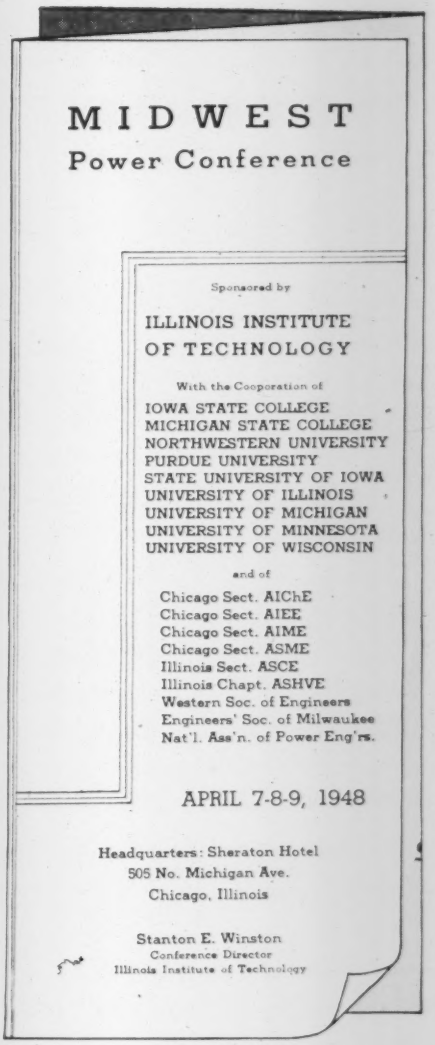
The use of a dry superheating section performs a dual function. First, the temperature of the refrigerant gases entering the main condenser coil will be cooled due to the removal of superheat from the refrigerant and thus the tendency for scale to be formed on the condenser coil will be lessened, and second, the heating of the air leaving the unit lowers its relative humidity and tends to prevent condensation should the duct work pass through spaces where the temperature is below the dew point of the leaving air.

Provision can be made for subcooling the liquid refrigerant by passing the liquid from the receiver through a coil in the evaporative condenser and then to the expansion valve. The subcooled liquid refrigerant line should, of course, be insulated if the temperature of the liquid is below that of the surroundings.

One of the main problems in operating any type of evaporative cooling equipment is the concentration of salts in the water circulated. The building up of excessive salt concentrations can be minimized by the addition of fresh water over and above that needed for evaporation. The amount evaporated will be about 2 gal per hr per ton of refrigeration. An addition quantity of make-up water of the order of 1 gal per hr per ton should be injected into the spray system and a like amount bled from the sump.

Scale formation is another problem in operating evaporative condensers. The formation of scale has a decided effect upon the heat transfer of the unit and in excessive amounts may prevent proper distribution of the spray water by blocking out portions of the coil. Two solutions to the scaling problem are, first, proper design by the manufacturers of the coil, the quantity of spray water circulated, and the method of spray distribution; and second, the proper chemical treatment of the water with bleeding to prevent over-concentration.

—Ross J. Martin, department of mechanical engineering, University of Illinois, Urbana.



Simplified Procedure for Design of Panel Heating

The great majority of panel heating installations are in structures which depend on infiltration for outside air. In such cases the ventilation rate is usually between ½ and 1½ air changes per hour. A common and relatively effective installation method in such structures is to arbitrarily use a fixed fraction —often 100 percent—of the ceiling or floor or walls as the heating surface; when panel area is thus arbitrarily selected the design procedure reduces to the problem of determining the load on each square foot of panel, the required water temperature, and the lineal feet of pipe or tube that will be needed for the installation. Arbitrary selection of panel area need not appreciably affect the total cost of the installation provided adequate design consideration is given to the tube spacing and to provision of entering water at proper temperature.

To reduce to a minimum the time and effort needed for panel heating design, a simplified step-by-step procedure has been developed for use in *naturally ventilated* structures. This procedure is derived from the more exact and generalized heat balance design method which resulted from the cooperative research sponsored by the American Society of Heating and Ventilating Engineers and carried on over a period of years at the University of California.

The intent in this paper is to use these research results as the basis of a design procedure, but to reduce the method of presentation to the simplest possible form and to eliminate all calculations other than those which require no more than simple arithmetic. The simplified method does not sacrifice accuracy except insofar as it assumes a fixed ventilation rate corresponding to average conditions in a naturally ventilated room; in effect, the tables used with the method are merely compilations of some 1000 numerical solutions of the basic heat balance equations.

Steps in the Design Method

Step 1: Select panel location (ceiling, wall, or floor).

Step 2: Calculate the total surface area of the room (walls, floor,

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CEILING PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	96.4	93.6	90.8	87.9	85.1	82.2
.10	109.8	105.5	101.2	96.9	91.9	88.4
.15	123.3	117.5	111.7	106.0	100.2	94.6
.20	137.2	130.0	122.6	115.5	108.1	100.8
.25	151.1	142.3	133.5	124.9	116.0	107.3

WALL PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	91.1	88.8	86.7	84.4	82.3	80.2
.10	101.8	98.6	95.3	92.0	88.7	85.4
.15	113.0	108.5	104.2	99.9	95.6	91.2
.20	124.2	118.7	113.1	107.6	102.2	96.6
.25	135.2	128.7	122.2	115.5	108.9	102.3

FLOOR PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	87.2	85.3	83.5	81.6	79.7	77.9
.10	96.4	93.6	90.7	87.8	84.9	81.9
.15	105.8	102.0	98.0	94.0	90.2	86.2
.20	115.0	110.4	105.4	100.5	95.5	90.6
.25	124.6	118.7	112.7	106.7	100.7	94.8

CEILING PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	91.1	88.7	85.7	84.0	81.7	79.4
.10	101.9	98.3	94.8	91.2	87.8	84.2
.15	112.9	108.1	103.4	98.6	93.8	89.1
.20	124.0	118.2	112.0	106.0	100.0	94.0
.25	135.4	128.0	120.5	113.6	106.3	99.0

WALL PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	87.5	85.6	83.6	81.8	79.9	78.0
.10	96.6	93.7	90.7	87.8	84.8	82.0
.15	105.7	101.7	97.8	93.9	91.9	86.0
.20	115.0	110.0	105.0	100.0	95.2	90.2
.25	124.0	118.3	112.3	106.3	100.2	94.3

FLOOR PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	84.4	82.6	81.0	79.5	77.9	76.4
.10	91.8	89.2	86.9	84.4	82.1	79.6
.15	99.2	96.0	92.7	91.1	86.3	83.0
.20	106.8	102.8	98.6	94.5	90.5	86.4
.25	114.5	109.7	104.6	100.5	94.8	89.8

CEILING PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	88.0	86.0	84.1	82.0	80.1	78.1
.10	96.8	93.9	91.0	88.0	85.1	82.1
.15	105.9	102.0	98.1	94.0	90.2	86.1
.20	115.0	110.1	105.1	100.1	95.2	90.2
.25	124.5	118.4	112.4	106.3	100.3	94.2

WALL PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	84.6	83.0	81.4	79.8	78.2	76.5
.10	92.0	89.5	87.1	84.7	82.2	79.8
.15	99.5	96.2	93.0	89.8	86.4	83.2
.20	107.0	103.0	98.8	94.5	90.6	86.5
.25	114.7	109.8	104.7	99.9	94.8	89.9

FLOOR PANEL

U_e	Outside Design Air Temperature, t_o -20 F	-10 F	0 F	+10 F	+20 F	+30 F
.05	82.1	80.7	79.3	78.0	76.7	75.3
.10	88.0	86.0	84.0	82.0	80.0	78.0
.15	94.2	91.5	88.9	86.1	83.5	80.8
.20	100.5	97.1	93.7	90.3	86.9	83.6
.25	106.8	102.8	98.6	94.5	90.4	86.5

Panel Rating Btu/(hr)(sqft)	Center-to-Center Spacing of Pipe Coils or Grids 4"	6"	9"	12"
10	4.3	6.5	8.7	13.0
20	8.7	13.0	17.3	26.0
30	13.0	18.5	26.0	39.0
40	17.3	26.0	34.7	52.0
50	21.7	32.5	43.5	65.0
60	26.0	39.0	52.0	78.0
70	30.3	45.5	60.6	91.0
80	34.7	52.0	69.3	104.0
90	39.0	58.5	78.0	120.0
100	43.3	65.0	86.7	130.0
110	47.7	71.5	95.4	143.0
120	52.0	78.0	104.0	156.0

Table 1 (upper left)—Design Panel Surface Temperature, t_p, for Room Having Panel Area Equal to 17 Percent of Total Inside Surface Area

Table 2 (upper right)—Design Panel Surface Temperature, t_p, for Room Having Panel Area Equal to 20 Percent of Total Inside Surface Area

Table 3 (lower left)—Design Panel Surface Temperature, t_p, for Room Having Panel Area Equal to 23 Percent of Total Inside Surface Area

Table 4 (lower right)—Required Temperature Difference, Δt_p, between Mean Water Temperature in Coils and Design Panel Surface Temperature

Panel Surface Temperature	Ceiling	Wall	Floor
75	8	9	15
80	15	17	23
85	23	27	35
90	30	35	45
95	39	44	56
100	47	53	67
105	55	62	77
110	62	71	88
115	70	80	98
120	78	89	109
125	87	97	119
130	95	107	- -
135	103	116	- -
140	111	- -	- -
145	119	- -	- -
150	- -	- -	- -

Floor temperatures above 85 F are undesirable and above 100 F are prohibitive except on space not walked over.

Table 5—Panel Rating, q_p, in Btu per Hr per Sq Ft

and ceiling) and arbitrarily fix the panel area, A_p, as 17, 20, or 23 percent of the total area. (In most cases 20 percent will be the best selection, but in unusually cold climates—or with poor construction—use 23 percent; in unusually warm climates—or with well insulated construction—use 17 percent).

Step 3: Calculate the equivalent overall coefficient of heat transfer, U_c, from the equation,

$$U_c = (U_c A_c + U_w A_w + U_g A_g + U_f A_f) / (A_c + A_w + A_g + A_f + A_i) \quad [1]$$

in which the U terms are overall coefficients of heat transfer, the A terms are surface areas in square feet, and the subscripts c,w,g,f,i refer, respectively, to the unheated portions of the ceiling, walls, glass, floor, and inside partitions.

The denominator of Equation 1 is obviously equal to the total area calculated in Step 2 less the panel area. In cases where the temperature exterior to an exposed surface differs from the design outside air temperature, it is necessary to correct the term in the numerator of Equation 1 which applies to that surface by multiplying it by the ratio of 68 minus the actual exterior temperature to 68 minus the design outside temperature; such a correction is often needed for floors, but rarely for walls or ceilings.

Step 4: Knowing U_c (from Step 3) and the design outside air temperature, use the proper table (depending on the use of 17, 20, or 23 percent in Step 2) and read the design panel surface temperature.

Step 5: With the panel surface temperature from Step 4 use the last table to read the panel rating, q_p, in Btu per hr per sq ft. Increase this rating by 10 percent to take account of heat losses from the rear of the panel; the total panel rating is then $q'_p = 1.1\ q_p$.

Step 6: Determine the room heating load by multiplying the panel area (Step 2) by the total panel rating (Step 5).

Step 7: With q'_p from Step 5 use Table 4 to read the required temperature drop from mean water in the coils to the panel surface for any arbitrarily selected tube spacing between 4 in. and 12 in. This temperature drop, Δt_p, is practically independent of the tube diameter in the range from $^3/_8$ in. through $^3/_4$ in. OD; thus determination of tube *spacing* is part of the problem of design, but selection of tube *diameter* is left to the judgment of the designer and will usually be evaluated in terms of permissible pressure losses through the piping.

Step 8: Add the Δt_p of Step 7 to the panel surface temperature of Step 4 to get the mean temperature of water required at the panel.

Step 9: Divide the room heating load (Step 6) by 500 and again by the arbitrarily selected temperature drop of the water passing through the panel to obtain the required flow rate in gallons per minute. A widely used value of the water temperature drop is 10 F; when this value is used note that the temperature of water *to* the panel will be 5 F higher than the mean water temperature, Step 8, in the panel.—B. F. RABER, professor of mechanical engineering, University of California, and F. W. HUTCHINSON, professor of mechanical engineering, University of California and consulting professor of mechanical engineering, Purdue University.

Test Shows Performance of Two Types of Heating

THE FUNCTION of a heating plant is to produce an environment which will enable the human body to lose a controlled amount of heat without conscious bodily adjustments. Furthermore, under conditions of bodily comfort, this rate of heat loss from the body to the environment must equal the rate of heat generation within the body.

The losses from the body involve a complicated heat transfer process consisting of varying amounts of radiation to cooler surfaces, convection transfer to cooler air, evaporation from skin and lung tissues to surrounding air, and conduction transfer to cooler surfaces. If an unvarying proportion of these four component losses were required for comfort, the design of heating plants could be directed to a single set of factors. Fortunately for the individual who must live in the space, a fairly wide range of evironmental conditions can be maintained in which varying percentages of radiation, convection, evaporation, and conduction are involved.

Theoretically, any reduction in the radiation transfer of heat from the body to the surrounding surfaces can be compensated for by an increase in the convection transfer. With high temperature radiation surfaces, such as are used in the true radiant heating system, and with fairly large ventilation rates, a marked reduction in the ambient air temperature should be possible. In current American practice, however, low temperature panel systems, and practically negligible ventilation rates prevail. Some doubt exists whether or not the low temperature panel system which is commonly used will exhibit markedly different characteristics from the common convection type of heating system.

Two Types of Heating Tested

During the heating season of 1947-48 comparative tests were made between a convection heating

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system and a ceiling panel system in the Warm Air Heating Research Residence at Champaign. The convection system is referred to as a forced air system, although both systems utilized warm air delivered positively by means of a centrifugal fan. During this period the tests were conducted for a few weeks on one system and then for the succeeding few weeks on the other system. By alternating the plants under test it was possible to obtain performance characteristics of each plant over a wide range of weather conditions.

If any single conclusion may be drawn from the tests, it would be that the response and performance of the two systems were surprisingly similar. The differences in the results obtained were not as large as the proponents of the two systems have claimed. Undoubtedly, the largest single factor which is ignored in the usual design procedures, and which markedly affects the actual plant performance, is the source and magnitude of the vagrant heat.

If the performance of the panel system tested in this structure is representative of ceiling panel systems, some justification may exist for those engineers who claim that a panel system is "merely another method of introducing heat into the structure." If this assertion is true of panel heating systems in general, it is believed that simpler approaches to the design of the system would be justified. Since the results [obtained in the tests] apply only to the specific conditions and building [used in the tests] the authors are of the opinion that an extrapolation of the data and conclusions to other widely varying types of panels and structures is not warranted, and that similar comparisons on other structures and plants are desirable. —S. KONZO and R. W. ROOSE, department of mechanical engineering, University of Illinois, Urbana.

Problems to Be Solved in Applying Heat Pump

THE HEAT PUMP has been well publicized in the past two or three years with suggestions that it will provide the answer to many heating questions. There are some very definite problems to be solved in applying the heat pump and until solutions are found, over-enthusiasm may lead to many mistakes. On the other hand, if heat pump equipment can be properly developed and applied, it has certain very definite advantages that warrant careful research and investigation.

[In addition to space heating], the heat pump can be used advantageously in many industrial installations for evaporating various products, such as milk, brine and pharmaceuticals, and for heating of water. In evaporation, 1 kwhr input to the heat pump may evaporate 20 to 50 lb of water depending on the operating pressure and temperatures. The heat pump has been used equally satisfactorily for water heating service, the largest unit built so far having a capacity in excess of 200,000 lb per hr of water and requiring 4000 kw input to the driving motors. Development work is under way of small water heating units.

At the present time, the earth itself seems the most practical source of heat for the heat pump where climatic conditions are similar to those around Chicago.

Earth Is Practical Heat Source

The calculation of how much heat can be removed from the earth is not a simple problem. Some of the variables are kind of soil, moisture content, density, specific heat, thermal conductivity, vapor content, and latent heat of the soil, moisture and vapor movement through the soil, coefficient of heat transfer between soil and heat collecting pipes, and the size and arrangement of the pipes in the earth. The suitability of the installation to absorb heat during the cooling cycle must also be considered.

Some of the above items are easily measured, others can be determined in the laboratory but with difficulty in the field, and others are the subject of research to find a practical method for their determination. The problem is further complicated by the change in earth temperature conditions during the year and by the tendency toward recovery to normal conditions when the heat pump is not in operation.

If all the characteristics of the soil were known, the method of calculating the possible heat flow to the collecting pipes is yet to be determined. Some work on this phase of the subject has been done by a few physicists and engineers, but completely satisfactory and acceptable formulas have not yet been disclosed. Incidentally, such information will need to take into account the need for complete recovery of earth temperature conditions during the summer months so that adequate heat will be available during the next heating season. The operation of the heat pump as a cooling unit during the summer with the heat pumped back into the earth may help to restore normal conditions.

The organization with which I am associated is conducting an investigation of the earth as the heat source, solely on a laboratory basis.

There are two complete test installations using horizontally buried copper tubing as the heat collecting equipment. The only difference is that in one case the tubing is 2 ft and in the other case it is 6 ft below the surface. In addition to the usual refrigerating equipment there is a complete set of instruments for measuring the amount of heat absorbed from the earth, temperature in the earth near the pipe, and also at a remote point that will not be affected by the buried pipe system, and instruments for recording the weather conditions.

There is a third installation employing the well system with the recirculating pipe inserted in it.

Each of these three systems is operated with the temperature in the evaporator not less than an arbitrarily selected minimum value, about 20 F for the buried tubing and 25 F for the well system.

The refrigerant is expanded directly into the buried tubing while a chiller is used to absorb heat from the liquid which is pumped through

the circulating pipe which is submerged in the well. An alternate arrangement for the buried tubing system would be to circulate a suitable liquid through it and through a chiller. It would cause additional loss.

The heat absorbed from the earth is delivered by the compressors to water cooled condensers where it is discharged to the cooling water.

Tests are to be continued for the entire heating season on an intermittent schedule intended to be representative of the demands for heat from day to day. It is expected that the data from the tests will supply information not now available for at least a tentative estimate of the amount of ground coil that will be required for an installation and whether the installation will be economically practical. —M. S. OLDACRE, director of research, Utilities Research Commission, Chicago.

Heat Pump Ground Coil Is Made Up of 40 Pipe Units

WHERE TO GET the heat for the heat pump—that is, the most feasible source—is "the big problem," according to a paper on Heat Source Possibilities of the Earth in the Milwaukee Area, by Charles H. Randolph, air conditioning engineer, and O. O. Wagley, superintendent of industrial sales, Wisconsin Electric Power Co., which was presented by Mr. Randolph. He gave results of two tests on a well type, 3 hp, heat pump installation, and a preliminary test of the same equipment using a ground coil instead of the well.

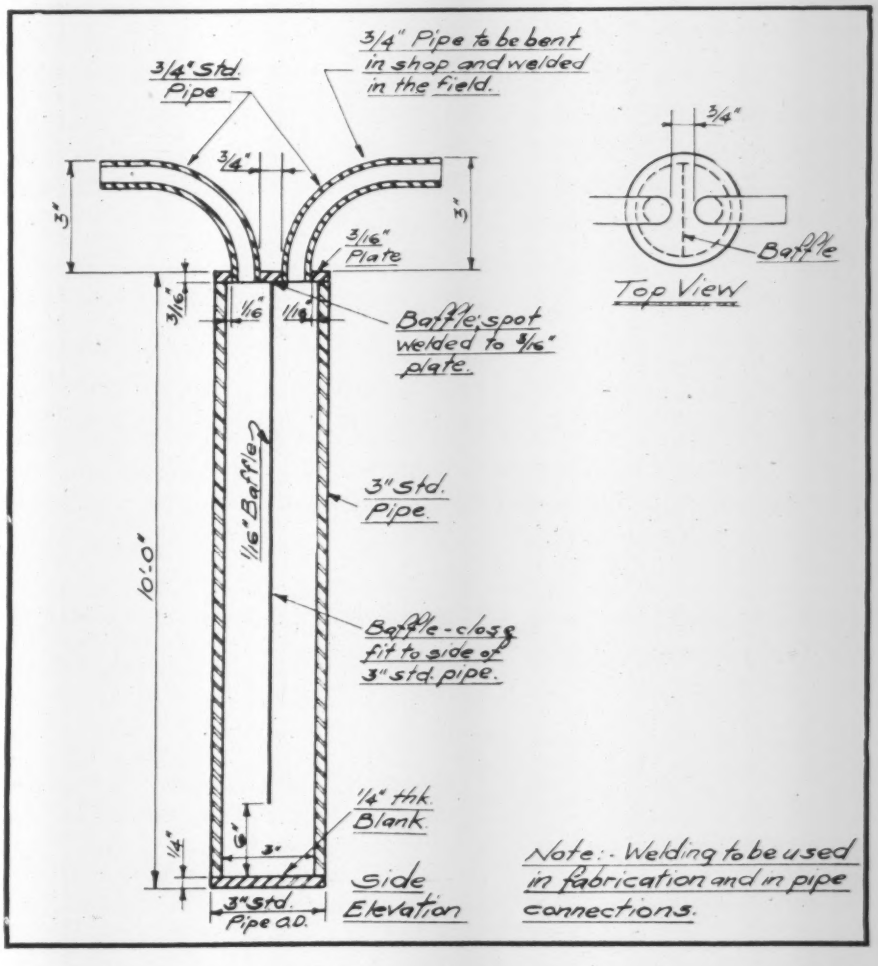
The well was 230 ft deep; in it was installed a U tube through which the circulating fluid was pumped to extract heat from the ground.

The speaker felt that a well of this type might be satisfactory for heat pumps in southern climates, but that in a northern climate the temperature gradient between the well casing and the U tube containing the circulating fluid adversely affects the coefficient of performance of the heat pump to such an extent that the scheme should not be used in northern areas.

If asked for a recommendation on a well job, the speaker said he would suggest a well with a center tube in the casing, the casing to be closed off at the bottom, with the circulating fluid going down the center tube and up around it in the well casing. This would eliminate some of the temperature differential between the circulating fluid and the earth.

The ground coil tested comprises 40 "vertical heat absorbing units" installed in an area of 40 ft by 75 ft. The units are connected as two circuits in parallel, the 20 units in each circuit being in series. Each of the units is a 3 in. black iron pipe 10 ft long, with a splitter down its center and almost to the bottom of the pipe. Connections for the circulating fluid to enter and leave each of the pipe units are at the top of the pipe on either side of the splitter. The 10 ft pipe sections are installed in 12 ft vertical holes, so that the top of each pipe section is 2 ft below the ground surface. A power digger was used to dig the 40 holes, and the holes were backfilled with the earth removed, being carefully tamped with a rod to get good contact between the outside surface of the 3 in. pipe and the earth.

Thermocouples were buried at various depths throughout the 40 by 75 ft plot of ground. Readings taken as the test progressed showed temperatures 7 ft below the surface varying between 58 to 39 F during the year, at the 12 ft level the variation was from 54 to 43 F, at the



The ground coil tested comprised 40 vertical heat absorbing units connected in series and installed in holes made by a power digger

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17 ft level it was from 51 to 46 F, and at the 22 ft depth, temperatures of the earth varied from 51 to 46½ F as the heat pump continued in operation.

Will Earth Recover Heat Content?

As a result of the test to date, it is planned to install similar ground coils but at greater depth in order to extract more heat from the earth. The new pipe units will be of 20 ft, rather than 10 ft, length and 44 of them will be used in the 40 by 75 ft area. The objective is to obtain a heat source at as high a temperature level as is possible during severe weather, and to determine if enough heat can be extracted from "an average size city lot" to do the heating job required.

The speaker stated that it was not as yet known if the ground would recover enough of its heat content during the summer to permit its meeting the heat requirements for the second season of heating. He indicated that it may be necessary—and should be economically possible—to recharge the earth during the summer by using the heat pump to extract heat from outdoor air and introduce it into the earth.

Mr. Randolph mentioned that with a coefficient of performance of 3.25 with such a heat pump installation for a structure having a design heat loss of 70,000 Btu per hr, and with a power rate of 1.7¢ per kwhr, "fuel cost" for the heat pump would be equivalent to No. 2 oil at 15¢ a gallon, burned in "a well designed job."

Preventing Corrosion of Condensate Return Lines

As early as 1924, the problem of corrosion of steel due to the presence of carbon dioxide and oxygen in condensate was recognized. It was determined by Whitman, Russel, and Altieri[1] that the carbon dioxide present in solution in condensate was highly contributory to this type of corrosion. Several other later investigators verified this conclusion. In 1939, Collins and Henderson[2] further verified these findings, and in addition illustrated that it was possible to experience serious corrosion in condensate return systems at very low carbon dioxide concentrations, particularly under conditions of high condensate flow rate.

During 1942, Skaperdas and Uhlig[3] completed an extensive study of the causes of condensate return line corrosion and reported upon the mechanism of such corrosion, based on their own experimental studies and those of other investigators. Their findings, briefly summarized, are as follows: (1) The corrosion reaction is essentially that between carbonic acid and iron. The probable products of this reaction are ferrous bicarbonate and ferrous hydroxide. (2) If oxygen is present in the same solution as the carbon dioxide, additional corrosion due to the depolarizing action of the oxygen at the water contacted surfaces will be experienced.

Field experience has indicated that these findings are substantially correct, since it has been shown over the past several years that the reduction or neutralization of the carbon dioxide content of return condensate has in an overwhelming number of cases reduced condensate line corrosion from a serious operating problem to one which is negligible. In some of these cases, it has also been possible to reduce the oxygen content of the condensate, as well as the carbon dioxide content. In these cases, condensate line corrosion has been almost totally precluded.

In most plants, however, it is not possible to reduce the oxygen content of a condensate because of system design. This is particularly true in vacuum return systems and in systems subjected to intermittent operation. These systems permit high oxygen inleakage to the condensate system and eventual solution of the oxygen in the condensate.

Sources of CO_2 in Condensate

The carbon dioxide present in a condensate can originate from several sources. These are:

1) The utilization of water for boiler make-up which contains a high concentration of calcium, magnesium, or sodium bicarbonate.

2) Excessively high make-up to a boiler plant of a water which contains low or moderate concentrations of calcium, magnesium or sodium bicarbonate.

3) Failure to employ a deaerating heater or deaerator in plants where the composition of the make-up water or the make-up rate to the boilers indicates that such equipment should be installed.

4) Selection of an improper method of chemical treatment of boiler water or improper control of any method of boiler water treatment.

5) The utilization of an improper or poorly designed or operated make-up water pretreatment system.

Where bicarbonate input to a boiler system is high, regardless of how the bicarbonate is combined or whether this high input results from the utilization of a water with a high bicarbonate content or from excessive make-up with a low bicarbonate water, the bicarbonate upon entry to the boiler is broken down, and as a result carbon dioxide is liberated in the boiler steam. This occurs regardless of boiler operating pressure. The higher the operating pressure, however, the greater and more rapid will be this liberation.

In some cases the employment of a deaerating heater or deaerator will cause some of this breakdown to occur in the deaerating equipment, providing this equipment is operated at or above the temperature equivalent to the boiling point of water. The carbon dioxide so liberated will be eliminated in the vent of the deaerating heater or deaerator. Less carbon dioxide will

[1] Whitman, W., Russel, R., & Altieri, V.; Ind. & Eng. Chem., 16, 665 (1924)

[2] Collins, L., & Henderson, E.; Heating, Piping & Air Conditioning, 11, 539, (1939)

[3] Skaperdas, G. T., & Uhlig, H.; Ind. & Eng. Chem., 34, 6, 748 (1942)

thus be admitted to the boilers with a consequent reduction of the carbon dioxide liberated with the boiler steam. Deaerating equipment properly operated will likewise appreciably reduce the oxygen content of the boiler feedwater and therefore preclude oxygen attack upon the feed lines, feed equipment, and the boilers.

The selection of an improper method of boiler water treatment, or—more important—the improper control of any system of boiler water treatment, is highly contributory to increase in return line corrosion. Sporadic or overtreatment of boiler water, with inadequate control of boiler blowdown, is probably responsible to a greater extent than realized in increasing the incidence and seriousness of corrosion of condensate equipment. This is because many of the chemicals used for boiler water treatment unavoidably contain materials which, upon reaction in the boiler, liberate carbon dioxide into the boiler steam. If the dosage of these chemicals is properly controlled in combination with adequate control of boiler blowdown, the minimum quantity of these materials necessary to maintain clean internal boiler surfaces, without excessive liberation of carbon dioxide into the boiler steam, will be used.

All pretreatment systems do not reduce the carbon dioxide or bicarbonate content of make-up water. For example sodium cycle softeners do not in any degree reduce the bicarbonate content of water. These softeners merely remove the scale forming salts of calcium and magnesium from the water and substitute non-scale-forming sodium salts. The bicarbonate content of the effluent of these softeners is exactly the same as that of the raw water entering the softener.

Evaporators likewise do not substantially reduce the carbon dioxide input to a boiler system. As in the case of a boiler, the bicarbonate entering the evaporator is broken down, due to subjection to the evaporator operating temperature, and as a result carbon dioxide is liberated in the evaporator vapor and hence into the boiler feedwater system.

Lime soda softeners, either hot or cold process, afford some reduction in the bicarbonate content of make-up water.

The development of exchange materials of a carbonaceous or resinous nature has permitted the design of softening-carbon dioxide removal systems which utilize acid or acid and brine for the regeneration of the softening materials. These units operate as softeners much in the same manner as the familiar zeolite systems. In addition, because it is possible to utilize acid to regenerate the exchange medium without damage to the material, the bicarbonate entering the softener is converted to carbon dioxide and is removed as a gas in the gas removal chamber or degasifier. With such systems it is possible to reduce the bicarbonate content of the degassed water to zero and the carbon dioxide content of this water is less than 5 ppm. Removal of the carbon dioxide by aeration in the gas removal chamber, however, saturates the treated water with oxygen. It is therefore essential that a properly designed and operated deaerating heater or deaerator be employed for removal of oxygen of water so treated. In addition, under certain conditions, it is possible to further reduce the carbon dioxide content of the treated water by elimination of this gas in the vent of the deaerating equipment.

It is realized that the economics of plant design do not always permit the installation of softening and/or carbon dioxide removal systems or in many cases even of deaerating equipment. Under these conditions, particularly where the boiler make-up is a high bicarbonate water or where the make-up rate is high, corrosion of the condensate return lines and equipment is a serious and costly problem.

What to Do Without Special Equipment

Where these conditions exist the following is suggested:

1) Reduce the condensate losses as much as plant operation permits.

2) Investigate the feasibility of installing deaerating equipment or improve the operation of existing equipment.

3) Examine the method and application of boiler water treatment in use. Also check for the possibility of excessive boiler blowdown.

4) Employ a condensate treatment designed to neutralize the corrosive effect of carbon dioxide in the condensate.

Reduction in condensate losses will produce the overall result of less bicarbonate input to the boiler system. This in turn will cause less carbon dioxide to be liberated in the boiler steam, which in turn will reduce the corrosivity of the return condensate.

In many cases plant performance and economy can be appreciably bettered by the installation of feedwater heating-deaerating equip-

The Value of Job Training

"The value of training applied to plant personnel has been proved. It is surprising to note the increased interest displayed by operators after they are exposed to fundamentals. Many an efficiency program has suddenly ended when the expert left the plant because he failed to sow the seed to propagate his work.

"Job training endeavors to expose fundamentals to the operator; to explain the objective; to invite participation in working out the details, and finally, to give credit promptly where such credit is due.

"There are many advantages to be expected from training work. Some men, prior to their exposure to fundamentals as taught in classes, appear uninterested with regard to advancement in their work. These same men may, after the formal training program is concluded, proceed on their own, taking other courses, purchasing books, etc.

"Training work discovers men. Some men discover themselves that they possess latent ability, but are unconsciously waiting for the opportunity to inspire their latent capacities into action."—Stephen C. Casteel, at the Midwest Power Conference

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ment. When the added benefit of the reduction in the corrosion of condensate return lines and equipment is accomplished, such installations are often economically justified.

Since improper or improperly controlled boiler water treatment will be contributory to increased corrosion of return lines, this angle should be considered in every case where return line corrosion is observed.

Neutralizing the Condensate

The neutralization of the corrosive tendencies of condensate, by the employment of alkaline substances, has been a plant operating practice for several years. Plant operators observed as long as 20 years ago that occasional carryover from a boiler system apparently reduced this type of corrosion. Based on these observations, the practice of bleeding a small quantity of boiler blowdown into the steam distribution system was followed. It was soon determined, however, that the suspended materials present in the blowdown water tended to plug condensate piping and equipment, which resulted in appreciably increased maintenance costs. This practice has, therefore, been largely discontinued at the present time.

Treatment of condensates with ammonia has also been attempted. In some cases remarkably good results were obtained. In a large number of cases, where this type of treatment was applied, however, the extreme volatility of the ammonia actually introduced a health hazard, since with a very small heating system leak, considerable ammonia was liberated to the atmosphere. In addition, serious attack upon copper, zinc, and any alloy of these materials was reported.

Use of Amines to Treat Condensate

During the past several years amines, which are volatile organic alkaline materials, have been applied to the treatment of return condensate for the prevention of corrosion of condensate return lines. These materials have various degrees of volatility. Therefore, it is possible to select a specific amine for best results at a given boiler pressure and for various return condensate temperatures. Very recently some of the various amines have been blended. This has permitted extension of the application of these materials over a wide range of operating conditions.

At the present time amine type treatment is not generally recommended for use at boiler pressures above approximately 300 psi because of the possibility of breakdown at elevated temperatures. Research is, however, being done with the object of extending the application of these materials to high pressure steam generating systems.

Berk[1], of the United States Bureau of Mines, recently published some results of extensive tests made with some of the amines in 1945 at a large Army post. In these tests the NDHA corrosion testers used by Collins and Henderson[2] were employed as corrosion indices. It was concluded, as a result of these tests, that amine treatment properly applied and controlled resulted in more inhibition of corrosion than was experienced with condensate not treated with amine, but which contained carbon dioxide concentrations as low as 5 ppm. These tests also showed that amine losses from a system were almost directly proportional to the water and steam losses. This, of course, precludes the economical application of amine type treatment to boiler plants with high make-up or blowdown rates.

Practice until very recently was to admit the amine in batches or by means of a proportioning chemical feeder to the boiler feedwater, usually at the boiler feed pump suction. From this point the amine would enter the boiler with the feedwater and be distilled off in the boiler steam. It was soon observed, however, that this was wasteful since it was often necessary to overtreat an entire steam distribution system to properly treat a part of that system where corrosion was severe and that relatively high amine dosage was required for effective inhibition.

Recent practice entails admission of the amine treatment directly to the steam lines. This permits feed of the amine at any point in the steam distribution system and at any desired concentration to inhibit corrosion where it is most serious. The entire condensate return system is incidentally treated by recycling, by return of the amine to the boiler and volatilization into the steam distribution system.

Injection to the steam distribution system can be accomplished by means of a chemical pump or by the employment of a condenser feeder arrangement.

In cases where high water and steam losses from a boiler plant and steam distribution system preclude the employment of amines for inhibition of condensate line corrosion, polyphosphates have been used with marked success. This material is injected to the steam system in the same manner as amines, i.e. directly to the steam line. Dosage is usually approximately 10 ppm based on total steam evaporated.

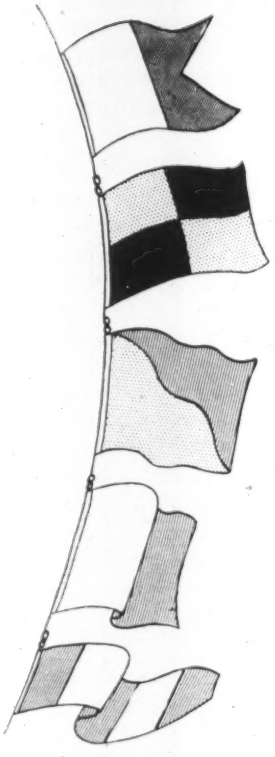
The polyphosphate forms a film of an iron phosphate complex which is visible. The film so formed protects the metal from both carbon dioxide and oxygen attack. Feed of the material must be continuous since the film formed is not permanent and must be constantly maintained.—R. T. HANLON, special service engineer, National Aluminate Corp., Chicago.

[1] Berk, A. A., Treating Steam Chemically to Reduce Return Line Corrosion. 1947 meeting of the National District Heating Association.

INVENTS NEW MAGNETIC FLUID CLUTCH

A new magnetic fluid clutch, controlled by small amounts of electric power "and characterized by high efficiency, smooth operation, long life, and simplicity of construction" has been invented by Jacob Rabinow of the National Bureau of Standards. The novelty of the clutch is based on the discovery by Mr. Rabinow that the frictional forces between solid surfaces and certain types of fluid media can be controlled by the application of magnetic fields.

Developed as part of the work on electronic computers now being conducted for the Office of the Chief of Ordnance, Department of the Army, the new clutch has possible applications in servo mechanisms, automatic control of machinery, in automobiles, and many other fields where ease of control and stability from low to very high speeds are important. The principle of the new clutch can be adapted with equal advantage to the design of brakes.



Design Engineer Reports On Operating Experience

JOHN H. CLARKE sought information on the problems with piping systems, pumps, valves, heaters, control, and other mechanical equipment faced by the operating man . . . how designs perform in actual service . . . how the equipment is really operated . . . when he (a marine design engineer by training and profession) shipped on a tanker as junior third assistant engineer. By the time his seagoing was completed (he's now back on land as a design engineer with the Standard Oil Company of Indiana) he got plenty of practical information on piping, pumping, heating, ventilating, and other subjects, much of which he has summarized in his articles, which conclude this month.

PRACTICAL PIPING PROBLEMS

AN IMPORTANT item that is often neglected is the running of machinery and drain piping. It seems to be a cardinal rule of operating engineers that they want to know *what* is draining from *where*. Also, they definitely want to be able to drain all equipment under all conditions.

Even though it was desired to conserve heat and water on these ships, this was no excuse for not providing bilge drains on drain lines that normally ran to some heat exchanger higher than the point being drained. Such a system works only when the machinery is operating and there is pressure on the system. When drains are run *individually* to the bilge, or through funnels to a drain tank, it is possible for the operating engineers to observe leaks or proper drainage. Had such drains been provided on the auxiliary turbines of our ship, the chances of damaging the turbine by filling the casing with water, and thus rusting blades, would have been minimized.

It is of the utmost importance to run individual lines. We had an unusually good trial crew for our ships at the shipyard and they were insistent on this point. My subsequent experience on the same type of ship certainly confirmed the necessity of this arrangement. I doubt if any operating engineer anywhere would object to it.

The Operating Engineer's Oily Rag

It has been a matter of interest to observe the old and revered tradition of the marine operating engineer of tending his duties, turning valves, and checking equipment with an oily rag as the chief accoutrement for the operation. To suggest the use of gloves is something nigh unto heresy. Gloves, to them, are supposed to be dangerous. The use of the oily rag is a carryover from the days of reciprocating machinery when oil could be wiped up practically anywhere. The prejudice against gloves probably comes from the use of improper types of gloves. Of course, as any sensible person knows, gloves cannot be used everywhere, and for some kinds of work they may be a hazard. But for the general protection of the operating engineer, they are certainly of great value *when of the right type.*

Somewhere I seem to recall an article on this subject wherein it was pointed out that for safety's sake and where working around hot equipment, gloves should have three features—they should be heavy and entirely made of leather; they should be of the gauntlet type; and, most important of all if you want to avoid being burned, they should fit loosely. This definition seemed to be confirmed by my observations.

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A survey of shore power plants would reveal that a good many of the operating men use leather gauntlet gloves. The marine operating engineer could well afford to follow suit. It was indeed interesting to observe that on the last ship, the most vociferous objectors to the use of gloves were devoted converts by the end of the trip.

Use of Generator Cooling Air

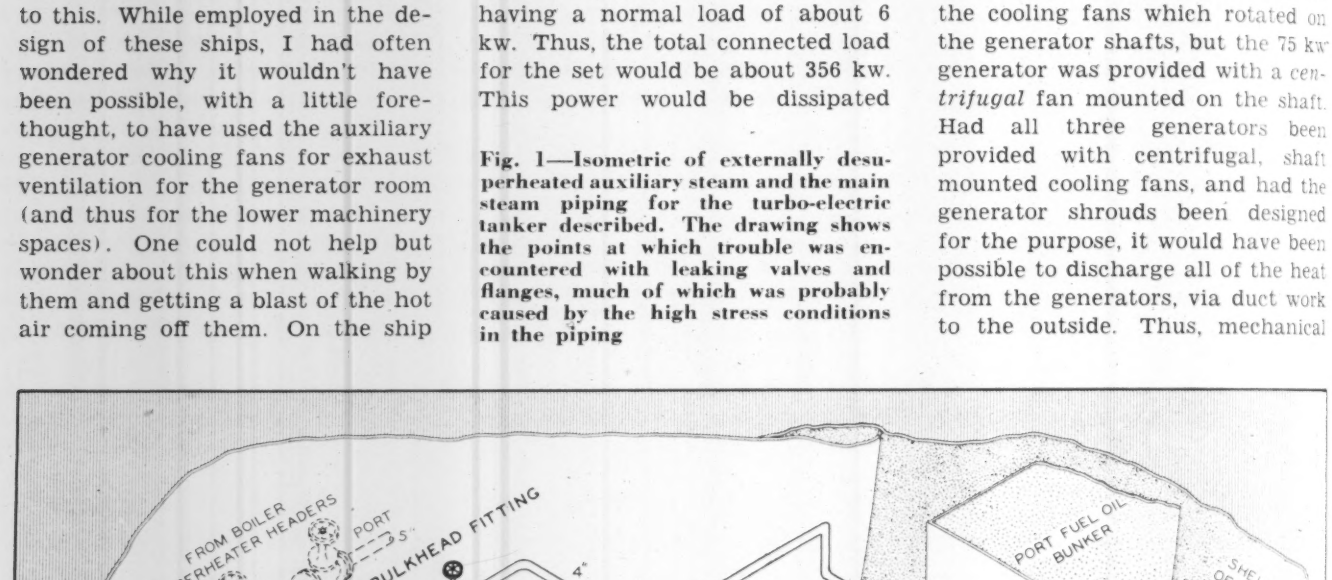
Most of the journey on the second ship was during warm or hot weather, excepting the short period at Baltimore prior to leaving. Consequently, for a person who is ventilation minded, it was natural to notice the operation of the equipment and of the ship with respect to this. While employed in the design of these ships, I had often wondered why it wouldn't have been possible, with a little forethought, to have used the auxiliary generator cooling fans for exhaust ventilation for the generator room (and thus for the lower machinery spaces). One could not help but wonder about this when walking by them and getting a blast of the hot air coming off them. On the ship upon which I last sailed, this auxiliary generator heat, which was blown into the generator room (in one end of the generator and out the other), contributed to a considerable degree to the extremely hot temperatures in the space.

The pertinent facts about these auxiliary generators are as follows: There were two generator sets, each rated at 525 kw, and turbine driven. Only one set was normally in use. Each set consisted of a 400 kw 60 cycle, a-c generator with a normal load of about 280 kw; a 75 kw main generator exciter with a normal load of about 70 kw; and a 55 kw generator used for auxiliary generator excitation, emergency excitation on the main generator, and the various d-c ship services; this unit having a normal load of about 6 kw. Thus, the total connected load for the set would be about 356 kw. This power would be dissipated throughout the ship. Consequently, the only heat chargeable to the generators as far as the generator room was concerned was the efficiency loss evidenced as heat and amounting to about 3 percent of the connected load, plus the excitation load to the auxiliary unit. The main (propulsion) generator was air cooled by a closed system incorporating water cooled heat exchangers.

On the basis of the above, there would be about 16.5 kw of heat [(350 × 0.03) + 6] dissipated in the generator room. This would amount to about 56,000 Btu per hr—*a considerable amount of heat.*

The 400 kw and the 55 kw generators were provided with the usual type of flat sheet metal blades for the cooling fans which rotated on the generator shafts, but the 75 kw generator was provided with a *centrifugal* fan mounted on the shaft. Had all three generators been provided with centrifugal, shaft mounted cooling fans, and had the generator shrouds been designed for the purpose, it would have been possible to discharge all of the heat from the generators, via duct work to the outside. Thus, mechanical

Fig. 1—Isometric of externally desuperheated auxiliary steam and the main steam piping for the turbo-electric tanker described. The drawing shows the points at which trouble was encountered with leaking valves and flanges, much of which was probably caused by the high stress conditions in the piping



exhaust of considerable quantity would be provided for the space, and the heat from the generators would have been eliminated.

It would follow from the above that the system could then be extended in usefulness by providing inlet filters for the generator cooling air, thus keeping them clean and keeping maintenance to the minimum. This is an item of importance. For the particular generators described above, it was necessary to clean them carefully about once a year in order to keep them in proper working condition.

It would seem that this sort of ventilation could be of considerable use in many industrial plants where moderate sized generators and motors are used. This would also seem to be a field of ventilation in which the ventilation engineer could work hand in hand with the generator and motor manufacturer, to the advantage of both. All large units are of course either hydrogen or air cooled by closed systems, but there must be thousands of smaller generators and motors that would lend themselves to this sort of ventilation service.

It is worth noting in this regard that the Navy Department did take steps in this direction for the auxiliary generators on many of their fighting ships. It was my understanding that because the generators were already installed and because the fans with which they were provided were of the flat blade propeller type, it was necessary not only to install an exhaust duct system for the generators, but also to supply centrifugal exhaust fans to blow the hot generator air to the outside. This same idea was at one time discussed with engineers of the Maritime Commission, although it is doubted that any positive steps were taken to develop the idea. It would be interesting to know how many such exhaust systems are now in operation, and what the possibilities are for further development.

Piping Stress and Flexibility

During the last several years, Heating, Piping & Air Conditioning has published numerous articles on piping stress and flexibility. It is something that too many of us know too little about.

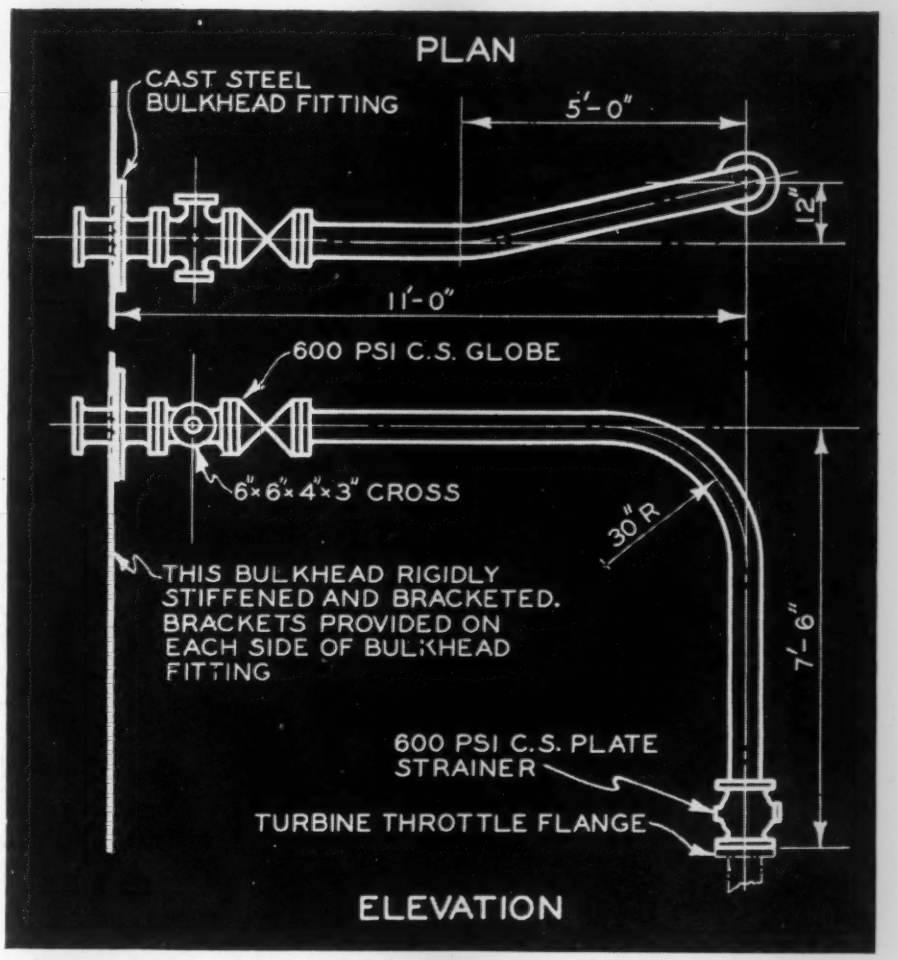


Fig 2—Details of main steam connection to the main turbo-generator. This pipe was not designed for proper flexibility and was considerably overstressed. The steam conditions for which this piping was designed were 450 psi and 730 F normal total temperature (763 F maximum). The pull-up, cold, was ⅛ in. at the turbine throttle, and at the 600 psi cast steel valve

Several of these articles* brought out a point well worth noting—that, while failure of the pipe itself rarely takes place because of improper expansion allowances, many times the high stresses and bending moments which result cause no end of trouble at the joints and other connections, resulting in leaking flanges and the overstressing of machinery and equipment.

Our ship seemed to provide many examples of this condition. Referring to Fig. 1, the valve at "A" is the desuperheater stop valve (mentioned in a previous issue) which could not be shut tight. This valve had twice been carefully ground in, but when in service in the hot condition it was apparently warped to the point where it would not seat tight. The stress in this case was caused by the improper design of the main steam piping to the main turbine. This pipe was too short to allow properly for the expansion in the hot condition and the pipe was stressed beyond the elastic limit and took a new set while hot.

With the system cold, the piping was again overstressed. This was proved when the bulkhead fitting at "C" was unbolted the last time the valve at "A" was ground in. In the free condition, the bulkhead fitting and the piping moved forward between 1¼ and 1½ in. The initial pull-up on this line was supposed to be ⅛ in. One of our engineers at the shipyard made a stress calculation on this piping and for those who are interested, the data on this pipe are shown in Fig. 2. The results of this calculation indicated a maximum combined stress at the turbine throttle of 44,700 psi, and a maximum bending moment

* See Pipe Wall Thickness Based on Total Combined Stress, by Otis W. Page, March 1946, pp.81-85; comments on it by Arthur McCutchan, May 1946, pp.77-78; and rebuttal by Mr. Page, June 1946, pp.86-88.

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at the same point of 44,100 ft-lb. The horizontal thrust at the turbine throttle (neglecting movement of the turbine, which in this case would have increased the thrust and stress) was 10,540 lb and the vertical thrust 5560 lb. This excessive stress was checked by calculations made by other engineers, and the recommendation was made that the lead to the turbine be changed to provide a more flexible loop. For various reasons the change was never made.

There is an interesting anecdote with regard to this particular turbine steam pipe. At the shipyard we had been suspicious of this piping and often wondered if an analysis had been made to check the design. But being very busy, we didn't get an opportunity to do any checking ourselves. Finally, prior to rechecking and correcting our plans for a new contract for additional tankers, we took advantage of an opportunity to inspect a tanker built by one of the well known east coast shipyards. On that ship, it was noticed that the steam pipe to the main turbine had an extra loop in it, thus providing a very flexible connection to the turbine. We immediately concluded that someone had discovered that high stresses did exist in the old design, and that the change had been made to correct this difficulty. This was a logical conclusion because many changes were made in the design of these ships and quite frequently we never learned of them until long after they were made, if ever. In any case, we immediately undertook the stress analysis referred to above.

Following the sea trips which I took aboard the tankers described in my previous articles, I had lunch with a friend who is closely associated with the design and operating end of one of the large oil tanker operating companies. In the course of the conversation, I happened to relate our findings at the shipyard with respect to the high stress in the main turbine steam pipe. It was also mentioned that we had noticed that one shipyard had changed the design, and that we had concluded that they had done so because of having checked and found that the pipe was subject to high stress.

All of this gave my friend quite a laugh. He doubted if the shipyard that made the change had ever checked the pipe stress. Because, he explained, he was on the trial trip of one of the ships, whereon it was decided to make the design change in the main turbine piping. But the reason for making the change was that an unusual condition of vibration had been encountered, and they wanted to eliminate it. This was accomplished by changing the run and length of the pipe. Apparently as a vibration dampening expedient, the change was successful. That the change also eliminated a high stress condition in the piping and at the turbine throttle was purely coincidental.

In reviewing this main steam piping, however, it should be mentioned that the main turbine stop valve at "B" gave trouble on these ships by leaking, as did the auxiliary generator valves "H" and "J." Probably the leaks in the latter were caused by wiredrawing in warming up the auxiliary turbine steam lines, but the stress factor cannot be entirely discounted.

Solid hangers were used for the system in the generator room, except that the main steam pipe to the main generator was supported by a constant tension spring hanger, and the steam lines to the auxiliary generators were supported by ordinary spring hangers immediately above the generator turbines. Also, it may or may not be significant (and most of the informed engineers say that it is *not*), but there was considerable trouble with leakage at the high pressure end of the main turbine casing flange of these turbo-electric ships. This problem became so acute that the flange bolting on the later ships was doubled.

High Stresses at Reducing Stations

At the reducing stations we had more evidence of high stresses in the piping. This complete assembly was carried on brackets welded to the bulkhead, and pipe straps were then bolted to the brackets. Supposedly, this piping was free to move through the straps; actually, it could not.

As a result, one of the ½ in. strap bolts at "G" was sheared off. Further evidence of high stress was indicated at "D", "E", and "F" where the flanged joints leaked for the entire trip. The valve at "F" was ground in, but was probably warped, because we could not manage to seat the valve. A new gasket was provided at "D" and the joint was carefully pulled up, but we still were never able to stop the leak. All of these flanges were of the 600 psi standard raised face type.

The conclusion that some men seem to reach is that if a pipe doesn't let go it must be all right, so why worry about it? The above piping difficulties seem to indicate that there is plenty to worry about if the operating and maintenance problems are to be kept to the minimum. Design engineers should ever be alert to these problems if they are to command any respect from the operating engineers. The operating engineers, however, must do their part in seeing that intelligent criticisms and reports on the operation of each design get back to the design engineer so that some benefit may be had from past mistakes.

Want Reprints?

Several subscribers have asked about reprints of the entire series of articles by John Clarke, Design Engineer Reports on Operating Experience, which concludes this month. If the demand is great enough, reprints will be prepared. It would be helpful in judging the demand for reprints if all those who might want them (for a nominal charge) would advise The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

FOUNDER OF PIPING FABRICATING FIRM DIES

Hugo Frederick Urbauer, 79, founder and chairman of the board of Midwest Piping & Supply Co., Inc., of St. Louis, died on March 25, at Phoenix, Ariz.

Born in Austria, Mr. Urbauer came to the United States at the age of 18. After working for several years as a steamfitter, he became division manager of a St. Louis furnace company. In 1899, he organized the Urbauer-Atwood Heating Co., and later formed the Midwest company, which has plants in Passaic, Boston, Los Angeles, and St. Louis.

Gas Stored at High Pressure in UNDERGROUND PIPE SECTIONS

D. V. MEILLER, staff engineer, Public Service Co. of Northern Illinois, Chicago, described the reasons for and methods of utilizing high pressure storage of natural gas in pipe sections buried underground at a recent meeting of the gas fuels and combustion section of the Western Society of Engineers. This new type of gas storage consists of random lengths (averaging 40 ft) of 24 in. OD, seamless, high carbon, alloy steel pipe

STORAGE OF GAS is a subject of great importance to the gas utility industry. The improvement of gas storage technique has been a challenge to a great many engineers who are active in development work.

The conventional type of low pressure gas holder is usually either of the water seal type or of the piston type (by low pressure is meant a fraction of a pound per square inch). Such holders serve many purposes in connection with the manufactured gas industry:

1) Levelling off the fluctuations in the hourly load, thereby permitting operation of the gas manufacturing facilities at an even output.

2) In cases of very high hourly or daily sendout, when the load may exceed the instantaneous capacity of the gas manufacturing facilities, the holder may be called upon to furnish the deficiency.

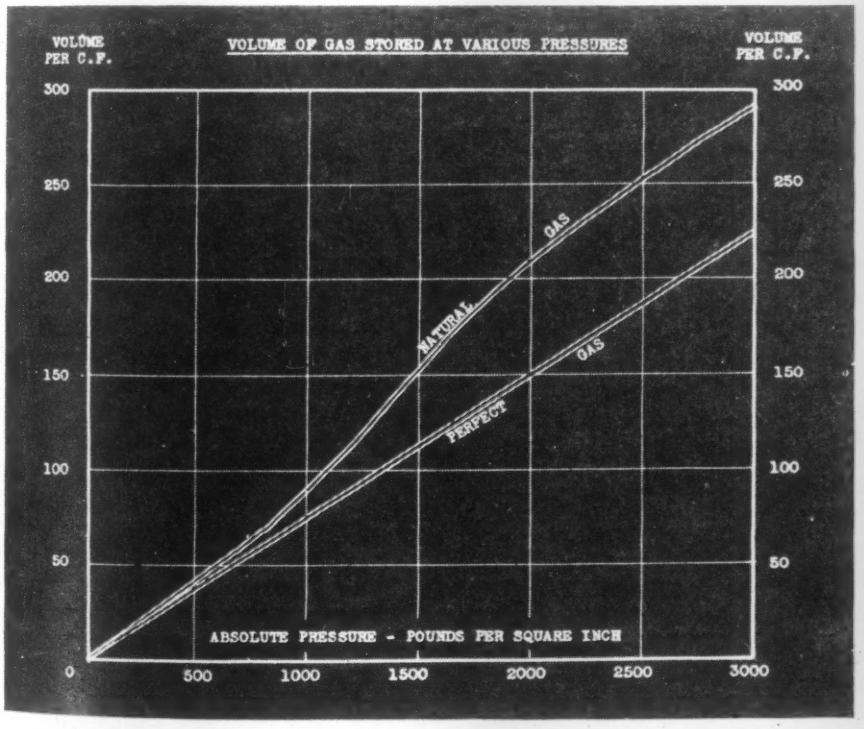
3) They provide a source of supply in the case of a temporary shutdown of a part of the gas manufacturing facilities for repair or maintenance.

4) In seasons of light load, the gas manufacturing facilities may be operated on less than a three shift basis by depending upon the holder for the hours when the gas requirements are low.

For these reasons, it is apparent that in the manufactured gas industry the gas holder and its operation is not only economical but necessary.

On the other hand, the early utilities that distributed natural gas did not generally find it necessary to install holders. Originally, the source of supply was not far distant from the distribution centers, and usually the amount of gas available was limited only by the pipe line from the field to the load center, so that in most cases it was more economical to install additional pipe line capacity than to build gas holders.

As the market for natural gas expanded—and with the development of long distance, large diameter, thin wall, steel, gas pipe lines of high capacity—many of the gas companies that formerly distributed



The natural gas does not obey Boyle's law for a perfect gas. This shows the pressure-volume relationship of a perfect gas and of natural gas as received by the Public Service Co. of Northern Illinois. Along the vertical scale is shown the volume of gas, measured at 60 F and atmospheric pressure, that can be stored in 1 cu ft of space. Along the horizontal scale are shown pressures. Note how the lines diverge; at 2240 psi pressure, approximately 43 percent more gas may be compressed into a given volume than would be indicated by the perfect gas law. This property of natural gas, commonly called supercompressibility, is one of the determining factors in making the high pressure storage economically attractive. If we were to plot a similar curve for air, it would follow closely, but not exactly, that for a perfect gas

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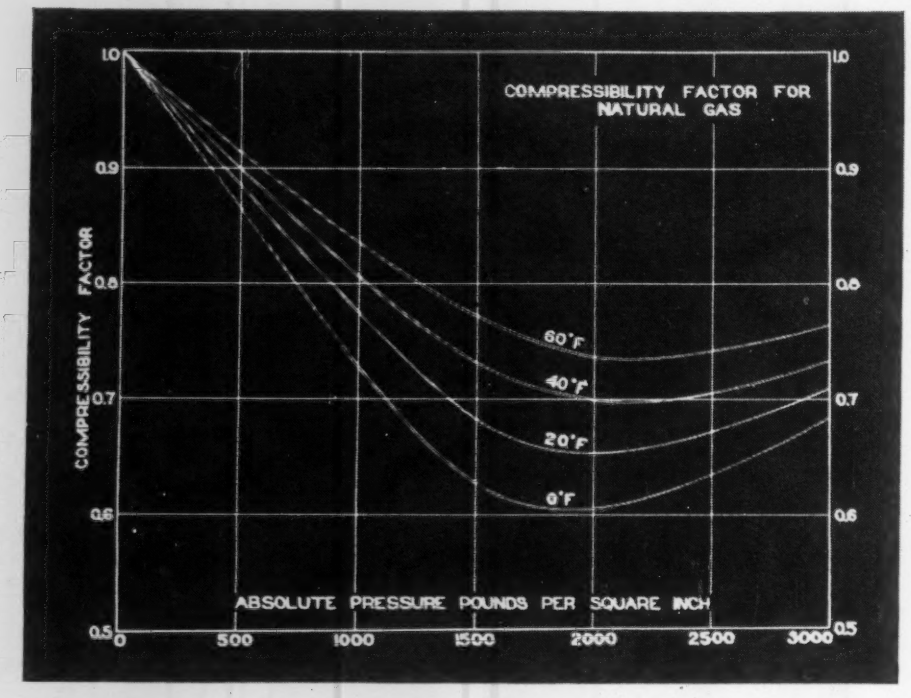


This shows the compressibility factor for natural gas at various temperatures and pressures. Along the vertical scale is shown the compressibility factor. Along the horizontal scale is shown absolute pressure. Each of these lines represents the compressibility factor at a certain temperature. These curves were made from calculated data, but later tests and experience have indicated that they are reasonably accurate. At the design storage conditions of 2240 psi and 40 F, the compressibility factor is less than 0.7 or near the optimum for the 40 F condition. At higher pressures the compressibility of natural gas again approaches that of a perfect gas

manufactured gas changed over to natural gas operations, or to a mixture of natural and manufactured. The economics of distributing natural gas by these companies is different than it was with the companies who started out with the distribution of natural gas from nearby fields. As the loads of these companies grow and exceed the capacity of the supplying pipe lines, the installation of additional pipe line capacity is more difficult from financial and physical aspects than in the case of companies close to the source of supply.

Large capacity, long distance pipe lines are in general very reliable facilities. However, no matter how capable or diligent the operators of such pipe lines may be, there is always the possibility of breaks in such pipe lines from causes beyond the control of the operators, with resultant temporary interruption of gas deliveries (either total or partial) to the ultimate distributor. Some utility companies served by long distance pipe lines are fortunate in having depleted gas fields near at hand in which they can store gas during the summer, and from which the gas can be later withdrawn and used for peak loads or in cases of emergency; however, many areas are not in this fortunate category. Where gas manufacturing facilities are not available, or where gas manufacturing capacity is insufficient to carry the load in an emergency, it is desirable to store gas locally in quantities predetermined by the excess of the load over the capacity of the gas manufacturing facilities.

Various Methods of Natural Gas Storage

The Public Service Co. of Northern Illinois last summer converted its northern operating division from 800 Btu mixed gas operation to natural gas operation. The load—which is predominantly residential—has grown very rapidly in the area north and northwest of Chicago. Of the 50,000 customers served in this area, about 12,500 are using gas for space heating. This space heating load has resulted in a very high peak load on cold days, thereby making more difficult the problem of storing gas in sufficient quantities to afford the desired system protection. Recognizing the desirability of some type of natural gas storage for this and similar situations, the company undertook a research program to determine the most feasible method of natural gas storage. Some of the methods considered were:

1) Conventional low pressure gas holders.

2) Conventional high pressure, above ground, gas holders, with pressures in the order of 60 to 100 psi.

3) Storage of natural gas in the liquid state at low temperatures and substantially atmospheric pressure.

4) Natural gas absorbed in propane, either at low temperatures and nominal pressures or at normal temperatures and high pressures.

5) Other methods—among which are absorption, and in hydrate form.

6) Gas stored at high pressure in buried pipe.

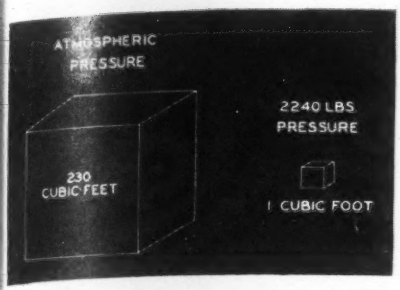
Some of the requirements for such storage are that it should be safe, reliable, subject to quick installation, it should have a low operating cost, the investment required should be reasonable, and it should not be unduly complex in design or operation.

After considering the various methods, it was decided that storage at high pressures in buried pipe was best suited to our particular problem and requirements. Accordingly, in 1946, the company designed and installed near Kankakee, Ill. a natural gas storage field of this type, which field stores 1.25 million cu ft of natural gas. This field served as a pilot plant.

24 In. Alloy Steel Pipe Sections Used

This new type of natural gas storage consists of buried random lengths of 24 in. outside diameter seamless, high carbon, alloy steel pipe, the average length being about 40 ft. To avoid field welding of this high carbon pipe, both ends of each length of pipe are swedged down and tapped for 1½ in. pipe thread.

Many of the costs entering into this type of gas storage—such as the cost of trenching, coating, laying, cathodic protection, land, etc.—are independent of the operating pressure; therefore, a high operating pressure obviously results in lower costs per unit of gas stored. The operating pressure selected was 2240



Approximately 230 cu ft of the natural gas, as measured at standard conditions, will occupy only 1 cu ft of space when stored at 2240 psi and 40 F. After determining that the idea of high pressure storage in pipe was technically and economically sound, the next step was to design a workable system. One of the problems of design was to obtain pipe of ample strength as prescribed by the code for high pressure gas piping. Another problem involved the arrangement and spacing of the pipe sections as to minimize loss of gas or physical damage of the facilities in event of some unforeseen failure of the storage facilities. Twenty-four inch, grade B steel pipe, as commonly used by gas and oil companies, was first considered, and it was found that a wall thickness of about 1 in. would be required to meet the piping code. Further investigation disclosed that an API N-80 steel would require a wall thickness of only about 0.45 in.

psi, at which pressure the compressibility factor of natural gas is near the optimum.

Because of the departure of natural gas from the laws of perfect gases, the stored volume of the particular natural gas involved is, at 40 F and 2240 psi, approximately 43 percent greater than the calculated storage of a perfect gas.

The compressibility factor becomes more favorable with decreasing temperature; therefore, it is desirable to bury the pipe at a depth which will result in reasonably low temperatures in winter (say about 40 F for the Chicago area), and yet minimize seasonal temperature changes. Due to the seasonal temperature changes, some gas must be withdrawn from storage in the spring and summer, and an equivalent amount put back into storage in the fall and winter. At the operating pressure of 2240 psi, each 1 F change in temperature will cause a pressure change of about 10 psi, of which about one-half is due to the change in the compressibility factor that accompanies the temperature change.

After the Kankakee installation proved entirely successful from both cost and operating viewpoints, a similar but much larger installation was made in our northern operating division at Mount Prospect.

The existing facilities for peak load and emergency supply to this northern division area consisted of a gas manufacturing plant with five carburetted water gas sets, and a 5 million cu ft low pressure holder. To provide additional protection against temporary failure or diminution of the normal natural gas supply, the company installed propane facilities and 40 million cu ft of natural gas storage in buried pipe sections.

These combined facilities have sufficient capacity to supply two maximum days load with a gas consisting of approximately 50 percent natural gas, 25 percent propane gas, and 25 percent carburetted water gas. Such a gas comes well within the range of acceptable burning characteristics. All of these facilities are so installed and arranged that any one or all may be used for "peak shaving" if desired—that is, if on a very cold day the load should exceed the quantity of natural gas available from the pipe line, the deficiency would be supplied by these facilities.

Installation of the Pipe Sections

A typical arrangement comprises 40 pipe sections of 25,000 cu ft capacity each, which makes up a 1,000,000 cu ft unit of storage. In each 1,000,000 cu ft unit, the pipe sections are spaced 8 ft end to end and 15 ft center to center line. Lanes approximately 50 ft wide separate the 1,000,000 cu ft units. The 40 pipe sections were selected as a convenient size of unit since it is well within the size or capacity that is easy to operate or to take out of service for repair.

At the Mount Prospect site, each such unit comprises only 2½ percent of the total storage of 40,000,000 cu ft. Thus, if any one unit of storage must be removed from service for any reason, the decrease in the quantity of stored gas is not of major consequence. The spacings will permit an ultimate storage of 70 million cu ft on the 160 acre tract of land with generous clearances from property lines, the compressor station, and a creek which wanders through the middle of the property.

Each 1,000,000 cu ft unit has a 2 in. manifold for filling and withdrawing gas. This is connected through a 2 in. valve to a 4 in. manifold header. The 4 in. manifold header serves six units, and is in turn connected through valves to two 8 in. manifolds leading to the compressor and sendout station.

As received, the pipe sections varied in length from 34 to 44 ft, the average being about 40 ft. Each pipe section had stamped on it a serial number for identification, from which it was possible to make a record of its length, and select for each row, pipe sections such that all rows were of fairly uniform length. This permitted the stringing of the pipe sections in advance of construction at the location where each length was later to be installed. This avoided stockpiling and sorting of the pipe sections on the site.

The storage pipes and other underground piping were coated with bitumastic and wrapped with asbestos felt to protect the pipe against corrosion. For cleaning a pipe section and priming the surfaces preparatory to coating and wrapping, the pipe section was on rollers, and was turned by a gear arrangement driven by a gasoline engine. The cleaning was done with air driven wire brushes. This work was done on each length at the spot where that length was later installed. This minimized the handling of the pipe after coating.

In the application of the bitumastic coating and the wrapper, the coal tar pitch was heated to about 400 F, at which temperature it may

Chemical and Physical Analysis of N-80 Seamless Pipe as Compared with Grade B Pipe

	N-80 Seamless API Spec. 5-A	Grade B API Spec. 5-L
CHEMICAL ANALYSIS		
Molybdenum	0.20% to 0.25%	—
Manganese	About 1.40%	0.35% to 1.05%
Phosphorus	Not over 0.04%	Not over 0.045%
Sulphur	Not over 0.06%	Not over 0.06%
Carbon	Not over 0.40%	Not over 0.30%
PHYSICAL ANALYSIS		
(Pounds per square inch)		
Tensile strength	100,000	60,000
Yield point	80,000	35,000

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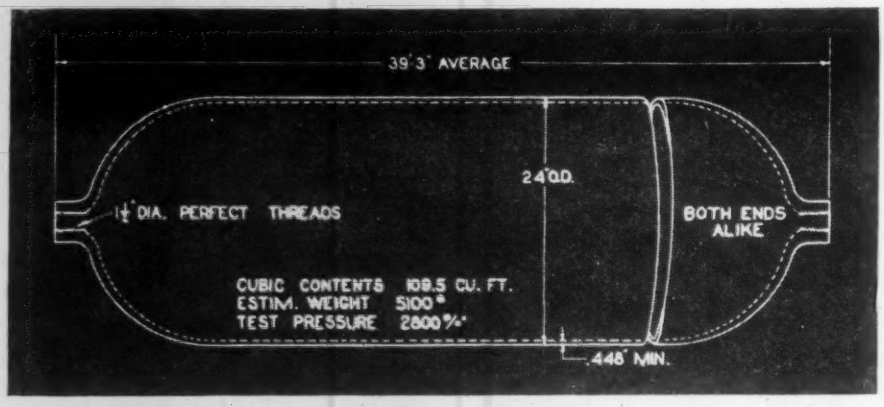


Due to the moly and the high carbon content, N-80 steel cannot be readily welded under field conditions; so, the fabricator, together with the company, designed a pipe section as indicated here. The fabricator was prepared to forge the ends to a hemispherical shape with a solid hub. In successive steps the ends are then rough bored, inspected for flaws, the entire length stress relieved, the ends finish bored and tapped with 1½ in. pipe thread to an ASA specification. Each length is then hydrostatically tested at 2800 psi in a waterfilled jacket, after which the pipe sections are dried, cleaned, primed and shipping plugs inserted in the ends. As the sketch indicates, the pipe sections are 24 in. OD, and about 40 ft. long. Each section will hold about 25,000 cu ft of gas at 2240 psia, which pressure is 80 percent of the test pressure of 2800. It may be of interest to know that 25,000 cu ft of natural gas weighs well over half a ton or in other words the gas stored weighs in excess of 20 percent of the weight of steel used in the pipe sections. The plant which does the forging on the pipe sections was used during the war for the fabrication of air cylinders for submarines

be poured on the rotating pipe. To further minimize corrosion, magnesium anodes were installed for cathodic protection. Flanges with insulating gaskets were installed in the 8 in. manifolds to electrically isolate the storage field from the compressor and regulator station and from the distribution system.

In other words, every effort was made to prevent corrosion. We believe that with proper periodic replacement of the magnesium anodes, this storage field will remain free from corrosion forever.

After the pipe had been coated and wrapped, it was tested with an electronic device that indicated any spots where the coating was unsatisfactory. There is an old saying that a chain is no stronger than its weakest link; this device detects the weak links. This device is now in common use for testing the coating on steel pipe lines, just prior to lowering the pipe into the ditch.

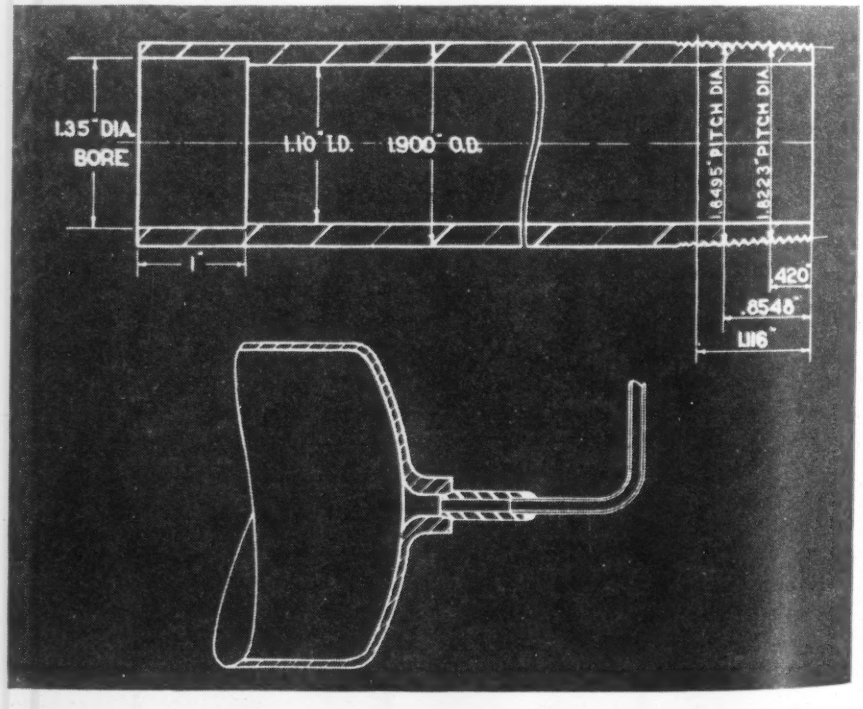
The pipe sections were connected together by expansion bends made from 1 in. extra heavy seamless Grade A pipe, electrically welded into the adapter. This is a socket weld connection made up of a minimum of three passes. The 24 in. pipe section is close to one wall of the 36 in. wide trench, so that the 24 in. offset of the expansion bend could be laid down to about a 45 deg slope or less. The threaded connections and all welds were left uncovered until inspected for leaks at full pressure.

As each 1,000,000 cu ft section was completed, it was pressured to 2350 psi with gas. As the gas cooled to ground temperature, usually within a few hours, the pressure would drop to about 2240 psi. All joints, both welded and threaded, were then tested for leaks by covering them with water. After inspection, the connections were covered with sand and the ditch backfilled.

Cost of Storage in Pipe Sections

This 40 million cu ft of storage was installed and in service only six months after the start of construction, and within one year after authorization to proceed. We considered this very satisfactory, particularly in view of the present slow delivery of equipment and materials.

The cost of this 40 million cu ft installation was in the order of $45 per 1000 cu ft of gas storage capacity for the storage field. The total cost—including the compressor sendout station, land, engineering, etc.—was in the order of $60 to $65 per 1000 cu ft of gas storage capacity. When the ultimate storage of 70 million cu ft is installed at this site, it is anticipated that the average cost per 1000 cu ft will be in the order of $55.



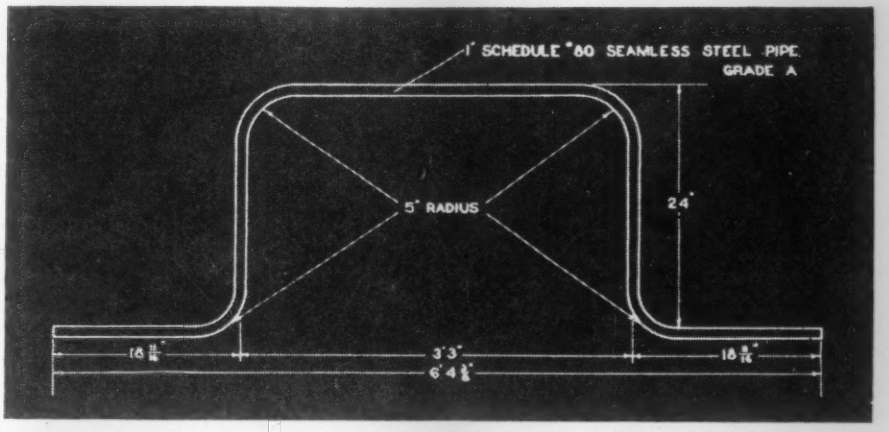
Shown here is a cross section of the 1½ in. adapters or pipe nipples for connecting to the storage sections. The adapters consist of short pieces of 1½ in. double extra heavy seamless Grade A steel pipe, threaded on one end and bored out on the other end to permit socket welding of the 1 in. expansion bend. Grade A steel pipe has a relatively low carbon content, and may readily be field welded. A lead base pipe joint compound was applied to the threads and the adapters were screwed into the special pipe 7½ to 10 turns. To secure engagement of this number of threads, it was necessary to use two men on a 60 in. wrench. The lower part of the sketch shows the adapter assembled in the pipe section and welded to the expansion bend

While there have been no conventional type gas holders constructed in this area recently, our best estimate is that the cost of such holders today would be in the order of three to five times the cost of high pressure storage in buried pipe sections.

The buried pipe type of storage has many advantages where it is applicable. Obviously, a considerable part of the favorable economics are incident to the supercompressibility of natural gas. Likewise, suitable land must be available at reasonable prices. About 75 to 80 million cu ft of storage capacity can be installed on 160 acres, with the spacing we have used. These are two limitations. On the other hand, the relative appearance and the freedom from above-ground hazards are certainly advantages. Also we are in the early stages of a development and are finding opportunities for lowering costs and improving flexibility of design which we believe will lead to further advantages.

With over 40 million cu ft of this storage installed and another 12.5 million cu ft under construction by associated companies, and with some 40 million cu ft planned for 1948 installation, our experience in construction and operation has shown it to be safe, reliable, economical, pleasing in appearance, and quickly installed. When required, a high percentage of the stored gas can be sent out at high rates of flow, with nominal investment in sendout equipment. We believe that this method of storage is ideal for many situations where natural gas must be stored.

The Stone & Webster Engineering Corp. engineered and supervised the construction of our Mount Prospect installation, and the Contracting & Material Co. was the contractor for the installation of the special pipe sections.



The expansion bends between pipe sections were made from 1 in. extra heavy Grade A seamless pipe. These bends were made hot and the end to end length was made such as to fit exactly in the field with no further bending or cutting. The expansion bends are designed to take care of expansion and contraction due to temperature changes and due to the change in length of the pipe sections by reason of changes in internal pressure

Ventilation Tips for Solvent Users

The operator or manager of the small plant or shop and the occasional user of solvents frequently need to be reminded that good ventilation is essential whenever and wherever solvents are used. Unless operations such as degreasing, thinning, cleaning, etc., are provided with adequate ventilation, workers may inhale sufficient quantities of solvent vapors to cause illness.

For occasional solvent operations, it is best to do the job outdoors on a breezy day, whenever possible. When the work must be done indoors, it should be carried out in an airy room near an open window. If adequate natural ventilation is not available, occasional small solvent jobs may be done safely by protecting workers with canister gas masks. Of course, the mask protects only the worker who wears it, and care must be taken that other workers in the room are not exposed to solvent vapors. For large jobs which are done only at intervals, a portable blower may be the most practical method of providing protection.

Where solvents are used constantly or frequently, it is usually necessary to provide special ventilating equipment. The equipment may be designed to ventilate the entire workroom. In this case, attention should be given to the area immediately around the solvent operation. For example, a man using solvent to wipe machine parts may be inhaling too much vapor, even if the air in the rest of the room is safe.

Often it is best to use equipment which ventilates locally—that is, which removes the solvent vapor at the point it is released, before it spreads through the workroom. Thus, a ventilated booth, an exhaust hood over the work bench, or a work table with ventilator slots around its edge, can protect the operator and also prevent contamination of the air in the rest of the workroom.

Large continuous solvent operations require the use of fully or partly enclosed equipment from which solvent vapor cannot escape. Even the small plant or shop may find such an installation worth while for an important solvent operation.

The operator of a small plant can obtain assistance on ventilating problems from the industrial hygiene service of his local health or labor department.—*Safety Research Institute, Inc.*

"RADIANT RAY HEATING" FEATURED

"Radiant ray heating" is the descriptive term which is being featured in the 1948 advertising campaign of the Institute of Boiler and Radiator Manufacturers in consumer magazines. It is explained that the term means "the warmth you get with radiators, baseboards, panels, or convectors."

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Solves Solution Mixing Problem With Pushbutton Control Layout

HOW TO DESIGN a solution mixing system with 1000 gal capacity per batch, to be operated from one point by one man, was the problem faced by Eastman Kodak Co. engineers. The new scheme replaces an existing method wherein solutions were mixed in lots of 50 to 200 gal, and involved operations at several locations. . . . The pushbutton panel system installed to answer the demands of this process is described.

EASTMAN KODAK engineers have hurdled a tricky barrier in the field of solution mixing. They have done this by putting into operation a new pushbutton panel system for mixing photographic solutions.

The problem was to design a solution mixing system with 1000 gal capacity per batch to be operated from one point by one man. Kodak's specifications demand that the solutions be kept free of contamination and that the highest quality standards be maintained.

The existing method was to mix the solutions in lots of from 50 to 200 gal. The procedure involved operations at several locations. Not only was the labor involved in mixing becoming unduly high but also the old system was simply failing to meet production demands.

One man can control the entire mixing operation from the panel

The problem was solved by means of panels from which one man can control the entire mixing operation in larger tanks. With the new method, an operator can now make 1000 gal of photographic solution in less time than he previously could make 200 gal. The operations are more systematic and the utmost in product quality is guaranteed.

How the New System Works

Here are the details of how the system works:

The operational key to the system is on the fourth floor and consists of two control panels. Each panel controls an individual, integrated system. The panels each contain switches for all pumps and agitators, liquid level indicating manometers, controls for supply and drain valves, drain and motor operation indicating lights, and piping connections for water supply and tank wash.

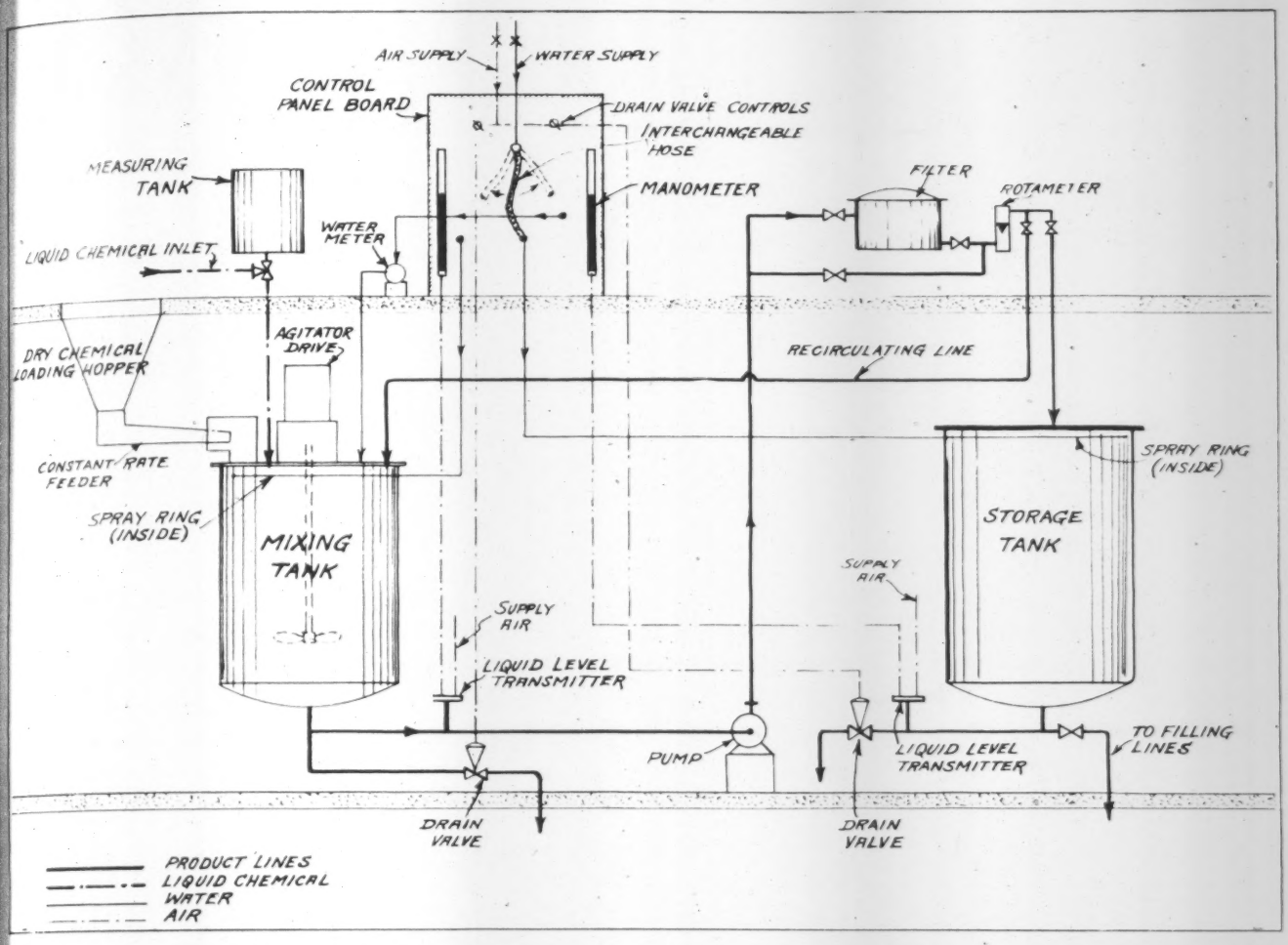
Also on the fourth floor are a chemical storage tank, two chemical measuring tanks, water meters, filter presses, and dry chemical loading hoppers.

The dry chemical loading hoppers are directly above the 1000 gal mixing tanks. They consist of a ventilated hood, a removable grating and a receiving hopper with a vibrating feeder below which dry chemicals are fed into the solution at a constant rate.

On the third floor are the two previously mentioned mixing tanks, two 1500 gal storage tanks, and supply connections to the filling machines.

Cutoff Allows Right Amount of Chemical

One of the automatic features of the system is a liquid cutoff that allows a predetermined amount of chemical to flow into the mixing tank and then automatically stops



This pushbutton panel system for mixing photographic solutions meets Kodak specifications that the solutions be kept free of contamination and that the highest quality be maintained

the flow. This frees the operator's time for other work during the filling period.

The cutoff is accomplished by a tee, which sends air to a pressure regulator. The tee is located on the air line between the liquid level transmitter on the mixing tank and the manometer. When the predetermined pressure is reached, an air relay bypasses air to the shutoff valve which stops the liquid flow. Accuracy to within 2 percent of the required volume is achieved by the cutoff.

A rotameter on each pump line between the filter and the storage tank shows the rate of solution being filtered at all times, and also affords visual observation of the solution during filtering. Thus, the clarity of the solution as well as the entry of any air into it are readily discernible.

The liquid level indicators consist of a transmitter located at the base of the tank and the indicating manometer on the panel board. The transmitter contains a diaphragm which receives the hydrostatic pressure in the tank on its under surface and a supply of 7 lb air on its upper surface. As the hydrostatic pressure varies, an air bleed-off nozzle in the upper portion of the diaphragm correspondingly changes the air pressure being transmitted to the manometer. This transmitted air pressure raises or lowers the level of the indicating liquid in the manometer.

Steps in Making Typical Mix

At the start of a typical mix, the operator draws the proper amounts of various liquid components into the tank. Then he weighs the dry chemicals into the loading hopper. With the 5 hp agitator turning, the dry components are fed by the vibrating feeder at a constant rate and go into solution very rapidly.

A laboratory test is taken and additional liquid chemicals are accurately measured in their individual measuring tanks. After necessary agitation and completion of photographic and other required tests, the circulating pump takes the solution through the filter and into the storage tank.

Washdown spray rings in each tank afford easy and thorough cleaning of the tank from the control point.

The tank is then ready for a new mixture.

[Note: A photograph and very brief discussion of this new pushbutton control system was published in the January HPAC; the above description, however, gives detailed information about its design and operation which was not available at that time.]

VALVE COMPANY EXECUTIVE DIES

Leon H. Marsh, vice president and secretary of the Kennedy Valve Mfg. Co., died March 11.

Mr. Marsh joined the company as traffic manager in 1918. He had been a member of the Valve Manufacturers Association since 1938 and was a director of the association in 1946 and 1947.

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INDUSTRIAL AIR CONDITIONING

Air conditioning has become a major mechanical feature of the modern industrial building, and the architect and the engineer must coordinate their efforts in order to produce less expensive and more efficient structures, according to F. F. Stevenson, designing engineer, The Austin Co., in this article, which is the first of a series

WHEN PLANNING AN industrial building, the architect is expected to create a design which is both utilitarian and, to a certain extent, decorative. He has four principal objectives:

1) The structure must adequately house the manufacturing machinery and apparatus, whose set up may be comparatively simple or exceedingly complicated.

2) The structure must shelter the workers, male and female, in a degree of comfort, that they may work at maximum efficiency.

3) The structure must house the mechanical equipment necessary to provide light, heat, power, ventilation, and air conditioning. The latter may mean simply cooling the air in summer or it may involve an elaborate control of the temperature, humidity, and supply of air all the year 'round.

4) The building must be decorative in a greater or lesser degree, depending on a number of factors not necessary to discuss here.

Needless to say, all of the above must be accomplished in a way and at a cost satisfactory to the owner.

Design Building Around Mechanical Equipment?

The importance and scope of heating, ventilating, and especially air conditioning have increased tremendously in the industrial field during the past 15 or 20 years. Air conditioning has become a major mechanical feature. Thus, the perennial question of whether the mechanical equipment should be designed to fit the building or the building designed around the mechanical equipment has assumed greater importance than ever. Unfortunately, in many instances it seems far from settled.

Such indecision has had an adverse effect on many industrial buildings. It has resulted in unsightly, last minute alterations to the structures themselves, has reduced efficiency of the mechanical systems, and has increased costs.

With the requirements of modern air conditioning, it is folly for the architect to think a satisfactory system can be designed to fit in a structure unless its needs have been anticipated well in advance. It is also folly for the mechanical engineer to expect the building to be designed solely for the purpose of housing the mechanical equipment. Both parties must assume a "give and take" attitude.

It is a fact, however, that liaison between the architect and mechanical engineer could be greatly improved, to the end result of producing more efficient and less expensive industrial buildings.

The engineer frequently complains—and rightly so—that the building design is settled long before the mechanical design is ready. In many instances, this is because the latter is held up until every last detail is completed, and the architect says "I can't wait, the building must go ahead, whether the mechanical trades are ready or not." On the other hand, many architects and engineers are able to make simultaneous decisions regarding architectural and mechanical design which accelerate the overall work on the building and avoid costly last minute changes.

Basic Design Can Be Set Up

A basic design for an air conditioning system, for example, can be set up from the very first. Its requirements can be noted and blended into the architectural design and become a fixed part of the structure. With such decisions made, the architect and engineer are free to go ahead with their respective spheres of work—the engineer secure in the knowledge that the mechanical equipment is provided for, and the architect without fear of being compelled to make last minute changes. Naturally, some adjustments and minor changes in dimensions will be required as the work progresses, but they will cause little difficulty.

The article of which this is the first part will try to demonstrate with several types of buildings how the architectural and mechanical design can be combined.

Two Methods for Cooling and Dehumidifying

Speaking generally, the designer has the choice of two basic methods for cooling and dehumidification. The first is to cool and dehumidify the air in a simultaneous process, so to speak, by reducing its temperature so that its leaving dew point is low enough to handle the latent heat load. The second is to dehydrate the air to the required point by one of several solid or liquid adsorbent or absorbent processes

and to sensibly cool it to the required degree.

If method No. 1 is used, there are three choices: (a) Well water exclusively. (b) Well water supplemented by mechanical cooling. (c) Mechanical cooling exclusively.

The selection of the right air conditioning system for any building depends upon an engineering analysis of the particular conditions affecting the project. It is thus impossible to generalize and to lay down a rule or set of rules to govern the choice of any one of the above-mentioned schemes of air conditioning. However, in his own work, the author has found that a "check list" of the factors to be considered is useful in assuring that no pertinent points will be overlooked in making the correct choice. In setting down these various items, it must be remembered that some of them may not necessarily apply at all under certain conditions, and that under many circumstances, some of the points mentioned will be outweighed by other considerations and will therefore not apply. The factors that the author checks are the folowing:

Well Water Exclusively

Check initial cost.

Check operating cost.

Check maintenance and depreciation costs.

Check space required for the equipment.

Check bulk and weight of equipment.

Check the control equipment required.

Check possible uses for water elsewhere in the plant after its cooling function has been fulfilled.

Check temperature of water to be sure it is low enough to meet the cooling and dehumidifying requirements.

Check effect of future curtailment or failure of water supply due to causes of nature or by governmental regulation.

Check possible corrosive qualities of water, obnoxious mineral matter, sand, or silt.

Well Water Supplemented by Mechanical Cooling

Check initial cost compared with 100 percent mechanical cooling.

Check operating cost compared with 100 percent mechanical cooling.

Check maintenance and depreciation costs.

Check space required for the equipment.

Check bulk and weight of equipment.

Check the control equipment required.

Check water requirement, and effect of failure or curtailment of water supply due to causes of nature or by governmental regulation.

Check flexibility of operation in accordance with load demand.

Check regulation of temperature to meet both sensible cooling and dehumidification needs.

Check effect of inefficiencies inherent with two separate systems.

Check possible corrosive qualities of water, obnoxious mineral matter, sand, or silt.

Mechanical Cooling Exclusively

Check initial cost.

Check operating cost.

Check maintenance and depreciation costs.

Check space required for the equipment.

Check bulk and weight of equipment.

Check the control equipment required.

Check regulation of temperature to meet both sensible cooling and dehumidifying needs.

Check flexibility of operation in accordance with load demand.

In general, if well water will fulfill the cooling and dehumidifying requirements of the system, and if the probability is that the supply will not be curtailed over a period of, say, 10 years, the author would say to use it. If well water does not meet these requirements, then a 100 percent mechanical system is the author's choice, with special circumstances in some cases indicating the use of a combination system.

Chemical Dehumidification Methods

The dehumidifying requirements or other circumstances of the particular job may be such that some form of adsorption or absorption dehydration of the air—rather than dehumidification by cooling below the dew point—is indicated as the right choice. Again, it is impossible to generalize, for there are many factors that influence the choice.

In our own work, experience seems to indicate that when leaving air dew points of around 42 F or less, or moisture contents of 40 grains per pound of air or less*, are prerequisites, then method No. 2 should be used. This is far from a hard-and-fast rule, however, as there are numerous other factors—both engineering and economic—that move these values either up or down for any specific case.

Following are some of the points, in check list form, that the author considers in the choice of equipment for method No. 2:

Activated Alumina

Check initial cost.

Check operating cost, including replacement of alumina charge.

Check maintenance and depreciation costs.

Check space required for the equipment.

Check bulk and weight of equipment.

Check the control equipment required.

Check temperature required for reactivation.

Check temperature of leaving air off dehydrator.

Check effect of interruption of dehydrating cycle.

Check effect of possible powdering of alumina and its getting into the airstream.

Check effect on dehumidifying capacity if air containing dirt, dust, lint, powder, etc., enters dehydrator in sufficient quantity to coat the top of the drying bed, thus raising the vapor pressure of the surface of the bed.

Lithium Chloride

Check initial cost.

Check operating cost, including replacement of dehydrating charge.

Check possibility of solution getting out of equilibrium due to variations in entering air temperatures.†

Check maintenance and depreciation costs.

*There are many installations in successful use where chemical dehumidification methods are employed to bring the moisture content of air down to some larger value than 40 grains per pound. The figure given above by the author is merely one used by him in his industrial air conditioning work, and should not be applied indiscriminately without an analysis of the particular job.—Ed.

†According to conflicting opinion, "variation in entering air temperature has nothing to do with the possibility of the solution getting out of equilibrium, this being due entirely to the temperature of the cooling water available and thus does not apply to the absorbent."—Ed.

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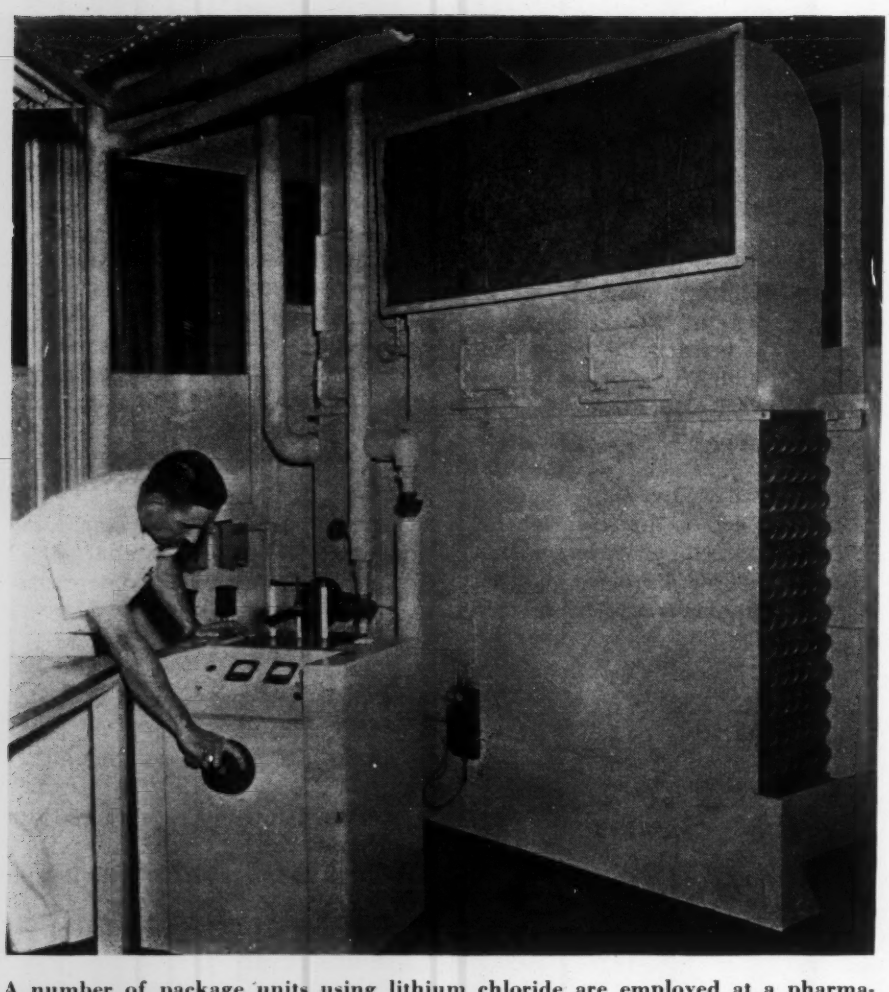

A number of package units using lithium chloride are employed at a pharmaceutical plant to maintain various conditions of temperature and humidity. Some of the spaces require 80 F and 10 percent relative humidity. Well water is used for controlling the dry bulb.

Check space required for the equipment.

Check bulk and weight of equipment.

Check the control equipment required.

Check temperature required for reactivation.

Check leaving air temperature off the dehydrator.

Check water requirements for dehydrating process.

Check if reheating is required in winter.

Check use as a humidifier in winter.

Check on effect of possible fouling of solution.

Check on protective measures for exhaust air duct work from regenerator against the possibility of corrosion.**

Silica Gel

Check initial cost.

Check operating cost, including replacement of gel charge.

Check maintenance and depreciation costs.

Check space required for the equipment.

Check bulk and weight of equipment.

Check the control equipment required.

Check temperature required for reactivation.

Check temperature of leaving air off dehydrator.

Check effect of interruption of dehydrating cycle.

Check effect of possible powdering of silica gel and its getting into the airstream.

Check effect on dehumidifying capacity if air containing dirt, dust, lint, powder, etc., enters dehydrator in sufficient quantity to coat the top of the drying bed, thus raising the vapor pressure of the surface of the bed.

A combination of methods Nos. 1 and 2 is sometimes indicated, especially when the dehydrating requirements are severe or when large proportions of outside air are used. A preliminary stage of dehumidification with any of the processes of method No. 1, followed by chemical dehydration to complete the cycle, may show a reduction in cost compared with the use of one method exclusively. An example of this would be the dehumidification of the outside air alone by means of method No. 1, followed by the chemical dehydration of the total air supply (outside and return).

[*Mr. Stevenson's next article will discuss multiple direct expansion units, central systems using chilled water, condensing water cooling, etc.*]

WSE MOVES TO NEW HEADQUARTERS

The establishment of a research center where engineering organizations may gather became a reality this month when the Western Society of Engineers moved to its new headquarters at 84 E. Randolph St., Chicago.

W. V. Kahler, president of the 79 year old organization, has estimated that the society will spend approximately $100,000 in renovating and equipping the center. When finished, it will include meeting rooms, offices, lounges, and dining facilities.

REMA ELECTS HILDRETH

H. F. Hildreth, sales manager of the refrigeration specialties division of the Westinghouse Electric Corp. was elected president of the Refrigeration Equipment Manufacturers Association at its annual board of directors meeting last month. Other new officers are K. B. Thorndike, vice president, Detroit Lubricator Co., vice president; R. H. Israel, sales manager, Virginia Smelting Co., treasurer; G. M. Kingsland, sales manager, specialties division, Minneapolis-Honeywell Regulator Co., secretary.

These new officers, with E. M. Flannery, vice president, Bush Mfg. Co. and retiring REMA president, comprise the association's executive committee.

**According to conflicting experience, no trouble whatever has been experienced with duct work from the dehumidifying unit corroding except in one or two cases where moisture condensed and ran back through the exhaust duct from the regenerator parts. This "was due entirely to condensation in the air from the regenerator and thus does not apply to the absorbent."—Ed.

High Temperature Water Heating

HIGH TEMPERATURE water heating systems, sometimes called high pressure hot water systems, were first designed in 1920 by Mr. Klingelhoefer of the I. G. Farben Co., in Troisdorf, Germany. He obtained basic German patents on this heating system. Between the years 1920-1926, several of these high temperature fluid installations were made using Mr. Klingelhoefer's basic idea of employing the boiler drum as the expansion vessel for the system.

The real development began in 1928 when serious research was started and designs developed coping with the various technical problems encountered in earlier installations. Extensive and expensive development was accomplished which resulted in good design of equipment required in the system. Throughout Europe, and since 1934 in England, many companies have been active in utilizing the patents and engineering knowledge acquired by this basic research.

The Temperature Drops Used

J. R. Kell, who has followed the development of this system in England, points out in a very excellent way, in his article in the April issue, the advantages of the system. I would like, however, to state that the modern design of space heating systems in high temperature fluid do not use temperature drops of "only" 100 F. Most of the systems which I have designed utilize temperature drops of 150 to 200 F. Flow temperatures are generally raised above the 300-350 F limit indicated in the article. Flow temperatures of 380 to 400 F and not exceeding 200 to 250 psig are normally applied and are seldom increased to over 400 F. In England there are plants operating at 600 psig, and in Germany there are plants working at 2800 psig. For America, high temperature water systems with pressures above 300 psig are not advantageous, in my opinion. Excellent chemicals are available for use as heat carriers for temperatures above 400 F without installing expensive high pressure equipment.

By utilizing large temperature drops, the water or fluid quantity contained in the system, and also the power required for circulation, are greatly reduced.

Some "Disadvantages" Really Advantageous

Some of the "disadvantages" listed by Mr. Kell are really important *advantages* of this system.

1) *The large water content* of the system—This large water content makes it possible to cope with peak load demands by using the accumulation capacity of the system. In this way it is possible to overcome morning peak loads. In factories, process heating often exerts peak loads on the boiler which can be satisfactorily taken care of by the large heat storage capacity of this system. The system, therefore, acts as a moderator between heat demand and production. The boilers can be smaller, and the elimination of the peak loads considerably increases the efficiency of operation.

2) *Warming up in the morning* does not actually take longer, even though the system is out of operation for the entire night. Comparing the overall time required in the morning for warming-up, calculated from the start of the firing of the boiler, it will actually be found that high temperature fluid systems can be started up in a shorter time.

3) *A pipe break or leak* in a high temperature fluid system produces no disruptive or explosive effect. When a break occurs, the pressure is relieved on the water leaving the break and it naturally flashes into steam. The rapid expansion of this steam acts as a refrigerant, similar to a steam jet refrigerator. We often demonstrate this by opening a $\frac{1}{2}$ in. or larger valve to the atmosphere and holding our hand within 1 or 2 ft of the opening without any danger.

4) *New circuits*—It is mentioned by Mr. Kell that you cannot add, with impunity, new circuits to the system. This is only partly correct, as this statement applies actually to any engineered pipe system or any engineering design. You cannot safely load a floor designed for 200 lb per sq ft with 800 lb per sq ft. A heating system, however, only ceases to perform satisfactorily if you overload it excessively. Any type of system has exactly the same limitations as high temperature fluid systems. It is possible (and I am doing this every day) to design systems with spare capacity so that additional branches can be added whenever it is wished.

Mr. Kell has undertaken the very difficult task of *comparing pipe sizes*. Curves could be prepared which are much more favorable or less advantageous to high temperature fluid heating systems. It requires experience to utilize the

"OPEN FOR DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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great advantages in pipe sizes offered by this system.

5) *The output of the heat emitting surfaces* is often equal, sometimes smaller. It is possible to obtain a greater heat output from a coil by using high temperature fluid. I fully agree with Mr. Kell that it is very difficult to make an actual comparison in the face of so many variables.

6) *For process heating*, variation in heat output and changing from heating to cooling can be obtained by using a fluid heating system. These problems are encountered very often in heating of calenders, presses, etc.

A uniformity of surface temperature is obtainable with fluid heating systems.—PAUL L. GEIRINGER, chief engineer, American Hydrotherm Corp., New York City.

REDUCING HEATING STEAM CONSUMPTION

I READ WITH interest the article by William B. Pride in the April issue in which he describes, in considerable detail, his method of continuously checking steam consumption for heating. The author has covered the subject with such thoroughness that any building operator or manager, even though unfamiliar with some of the elementary principles of economical heating, should be able to set up a system for reducing heating costs.

As pointed out in the article, the measure of steam consumed per thousand cubic feet per degree day is as practical a yardstick for heating steam as is now available. Although this does not take into consideration wind, humidity, sunshine, and, other variable items, the chances are that these average out fairly well over a heating season, so that they should not affect, materially, the long term results—although they may cause variations in the diurnal consumption.

Our experience has shown that for large properties it is worthwhile to take the time to make daily calculations on a degree day basis and to install recording instruments such as thermometers, pressure gages, vacuum indicators, etc. In the small properties where the consumption does not warrant this detailed control, the checkup is made monthly. For all properties, the monthly and annual consumptions per degree day are recorded and used to determine relative efficiencies and to correct abnormal conditions.

There is no question that if all buildings were checked with the care employed by the Boeing Airplane Co. the fuel consumption of the country would be materially reduced and some of the shortages which we have experienced in recent years might not have developed.—L. W. MAUGER, supervising engineer, Brown, Wheelock, Harris, Stevens, Inc. (real estate), New York City.

SIZE RANGE OF ALUMINUM PIPE

IN THE ARTICLE, Aluminum Piping—How to Use It, by C. B. McLaughlin, published in the April issue of HPAC, Table 5 gave the size and thickness ranges of wrought aluminum and aluminum alloy pipe, tubing, and butt welded fittings and flanges. The size range for cold drawn seamless pipe is from ⅛ to 11 in. instead of ⅛ to 12 in., as was given.

WHAT ARE THE PROPER AIR CONDITIONS?

REFERRING TO the comments on What Are the Proper Air Conditions?, on pages 109 and 110 of the March issue, I agree with John O. Johnson on his conception of air conditioning. We all know it is impossible to have an ideal condition where everyone would be comfortable at the same time. I assume that we will all agree on this fact.

The ASHVE Research Laboratory has given an extensive study to acclimatization. The ASHVE Guide refers to no greater temperature difference than 15 F. Since cost of equipment and operating cost are two of the main factors in air conditioning, to a customer, there is a considerable difference in the machine sizes in order to have a temperature differential of from 15 F to 25 F.

We shall let the doctor decide whether or not a great change in temperature has any effect upon the heart. Doctors will not recommend sudden large temperature changes. I believe a 25 F change is large. It is true that we have conditions in winter where there is a change of 75 F between inside and outside conditions. This is a different situation altogether, as acclimatization comes in at this point. Our blood has been thickened and slowed down. We also wear more clothing in winter than in summer, part of which is removed when entering a warm building.

There may be complaints when the inside temperature is 85 F even if the effective temperature is within the comfort range. As stated before, all the occupants cannot be satisfied with the humidity at 50 percent.

The statement made by H. E. Wheeler is true, as the thought of a doctor can cause a normal man to faint, when he is affected by nervous reaction.

The idea of keeping the thermostat out of sight of the occupants is a very important point. If the effective temperature is comfortable, and the occupant sees the 85 F on a thermometer, he is at once a very uncomfortable person. This is what is known as a "temperature-conscious" person. It is an established fact that the comfort zone covers several varied DB and WB temperatures.

Not only good engineering practice, but sound psychological principles are essential in selling the buyer. I have yet to find an installation where there was no psychology applied.

I agree with Mr. Wheeler that theater air conditioning is a subject in itself. But theater owners in general are not well informed on the subject of air conditioning.—O. L. SMITH, Curtis Refrigerating Machine Div., Curtis Mfg. Co., St. Louis.

Does Air Conditioning

ATTRACT BUSINESS?

As the Question of the Month in April, "J. O." asked . . . "What percentage increase in business can be expected in a store, restaurant, and hotel dining room, due to the installation of good summer air conditioning systems. . . . "

In the early 1930s a question of this kind had some significance because many of the good restaurants, stores and dining rooms did not have air conditioning. Summer trade fell off and by installing air conditioning, summer trade picked up. We used to use a figure of 30 to 40 percent increase in restaurant trade in the hot months. Store business likewise picked up, particularly specialty shops, shoe stores, dress shops, etc. A hotel dining room was considered the same as a first class restaurant.

As of now, 1948, such a question could be answered with anything from 1 to 100. Air conditioning cannot correct poor store practice. In other words, you still have to be a merchant if you are in the store business, and you still have to run a first class store. Air conditioning is a tool to work with just like lighting and show cases. One of the big advantages to stores is the saving in spoilage of goods. You will therefore answer the question in respect to the store as being simply a "must do." You cannot stay in business with a modern store *without* air conditioning.

You Can Get By—the Hard Way

In general, that is the same answer in a first class restaurant or in a hotel dining room. It is possible to run a dining room with good ventilation even though you do not have summer cooling, but it certainly is the hard way. The restaurant that does not have cooling must have some other special features to attract trade. Even so, the management is continually on the defensive, as even in some of these rare old dining rooms with high ceilings, ossified trade, prestige and sentiment, the management has to explain why it is so hot in hot weather. You can get by in a private club because members will patronize for other reasons but the competitive restaurant needs year around air conditioning with emphasis on good ventilation in order to do a profitable business.

This question could be answered by picking out specific installations where tremendous increases occurred when air conditioning was added. It could be answered by averaging out a group of installations of a similar type. The simplest answer to me seems to be that you hold your trade *and* increase it *and* sell a larger lunch check *and* you build employee goodwill—with summer air conditioning. What do you get without it?—L. T. A.

ROOF SPRAYS REDUCE AIR CONDITIONING LOAD

In answer to the question from "K.P." concerning roof sprays, published in the March issue, we can quote one job on which roof sprays applied to a plank and dry slag roof reduced the total maximum roof heat gain by 60 percent, based on measured roof surface temperatures, dry and wet. In this case sprays were added because the owner desired to increase the air conditioned space without adding additional refrigerating capacity and a check of loads and performance after the change was made indicated that the sprays accomplished the desired load reduction.

The savings indicated by our brief tests are not quite as pronounced as those reported from laboratory tests, but we have continued to use this estimated saving of 60 percent feeling that in so doing we allow a safety factor.

We have installed several roof spray systems in connection with air conditioning installations and found that the effect of the sprays always came up to expectations. The quantity of water required is surprisingly small and a brief calculation will indicate that the use of roof sprays will provide the cheapest possible "refrigeration" that can be purchased in most cases. We have used a portion of the waste condenser water for spray supply with perfect satisfaction, the higher water temperature seemingly making very little difference in the cooling effect.

Nozzles Must Be Cleaned

There are a few characteristics of roof sprays which may present prohibitive obstacles on some jobs. Nozzles must be cleaned at regular periods, measured in weeks or months depending on water cleanliness, and if the roof is inaccessible or the owner ill-disposed to provide regular cleaning, sprays had better not be installed.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

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Water runoff sometimes presents a problem. The water doesn't harm the roof, which was made to be rained on anyhow, and may even prolong the life of some roofs. But to insure a completely wet roof there will always be some surplus water which will be carried off in the same manner as rain water. Unless provision is made to carry this runoff to a sewer, there may be objections. Few people object to water dripping off the edge of a roof or flowing over the ground from a downspout when it is raining, but they can complain when it seems out of step with the weather. —L. B. N.

NOT MUCH WATER NEEDED FOR ROOF COOLING

REPLYING TO "K. P.'s" inquiry about roof sprays in the March HPAC, it is very easy to put plenty of water on a roof, but the amount that can be usefully employed for evaporative cooling purposes is on the order of 0.04 gph per sq ft. So little is not easy to dispense, yet the above figure is an ample amount; the reason for the great cooling effect it produces is that about 8750 Btu is required for evaporation of 1 gal of water. This is only a few Btu to a heating man, but it takes care of the space under a 50 x 50 ft roof for about 1 min in spite of the most intense sunshine.

"Take care" is, of course, an expression that requires defining. Every roof warms up in the summer and becomes the warmest part of the building under ordinary circumstances. It may be a heavy roof and the ceiling temperature may be only a few degrees above air temperature, but warm it gets if left to itself. With thin roofs the ceiling temperature rises sharply under the influence of the summer sun, and temperatures much above 100 F are common. As high as 175 F has been found on roofs.

A ceiling temperature above that of the human body means radiation onto those present in the room, especially onto their heads. In the summertime, when it is already difficult to dispose of the surplus body heat, such radiation is doubly annoying, to put it mildly. A wet roof on the contrary, being near the wet bulb temperature, causes the ceiling temperature to be *below* that of the body and therefore offers the occupants a surface receptive to radiation from them. Just as the jump from pedestrian to bicyclist is a bigger gain than from bicyclist to motorist in spite of the adverse proportion of the expenditures involved, so is the increase in comfort from nothing to roof cooling a much bigger gain than from the comfort condition in a roof-cooled space to that offered by the finest of summer air conditioning.

Cool Ceiling Means Comfort

In brief, give a man a cool ceiling and you give him thermal comfort.

To give some specific data from practice: A typical (though the theoretically least favorable) application is a building measuring 50 x 50 ft—2500 sq ft of roof area vs. about 1900 sq ft of wall area; only half of the latter is exposed to sunshine at most. A circular area of 48 ft in diameter is quite sufficient as design area. The slant of the roof usually causes water to run into the area beyond the circle, causing 2100 to 2400 sq ft to be wet at all times depending on the curvature of the roof. This has proved fully satisfactory.

The area left dry is cooled—less intensely but quite perceptibly—by cool moist air from the wetted area flowing toward the edge of the roof (and down the walls).

There is also an equalizing effect at the ceiling surface by flow of room air. Just as it is erroneous to believe that 100 percent coverage is noticeably better than 90 percent and justifies the additional expense, so it is erroneous to neglect the subceiling air flow.

Large sources of heat that are not being eliminated by the roof cooling reduce the noticeability of the cooling effect produced on the roof. For example, laundries are always hot, even if the steam pipes are insulated, and are not strikingly benefited by roof cooling, in my experience.

As to the question of how much the solar heat load is reduced—most important to the air conditioning engineer—it must be understood that roof cooling helps air conditioning in two ways: it counteracts the sun effect on the roof, and it produces an evaporative cooling effect.

Sprays for roof cooling inherently cause air disturbance, especially if their direction is changed, and they can produce more cooling effect than is required to nullify the sun effect on the roof. With a good system it is safe to figure with a design roof temperature 5 F above wet bulb temperature. While it is true that cool air flows off a cooled roof, the beneficial effect should not be relied upon to reduce the heat load of the walls.

The cooling effect obtained on the roof beyond nullifying the sun effect can amount to astounding thermal savings in cases where substantial heat storage is possible. Where the roof is heavy, or where heavy machinery or the like is present, 24 hr roof cooling can bring amazing results.—S. R.

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Those published are paid for at regular rates. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

ASKS FOR DATA ON CLEANING DUCTS

You are invited to comment on the following question from "F.F." Suitable comment on this matter will be published, and paid for at regular rates (with additional payment for sketches). Address The Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

"I would like to have information on methods of cleaning ventilating ducts and equipment, and the various solutions used to remove grease, etc."—F.F.

Read

Equipment Developments

in every issue!

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Here's an Idea: Put Town Inside Building

Maybe a structure such as suggested here will never be built, but some of the big wartime blackout plants aren't too different from Mr. Lewis' proposal, originally made in 1922. By roofing over an area half a mile square, a number of heating and other problems could be solved, it would rain when you wanted it to, and snow shovelling would be a thing of the past . . . . . .

In 1922 I delivered a paper at a local meeting of an engineering society. It embodied ideas inspired from experiences with the heating of the old Chicago Coliseum.

This paper suggested a large lofty building, covering an area half a mile square. (This, of course, was long before the development of air conditioned blackout war production factories such as became common, the country over, during World War II.) In this 1922 yarn, I developed the plan with glass skylights in the roof and with windows in the walls. The enclosure was to be provided with mechanical ventilation and there were to be rain water reservoirs on the roof between the skylights so that water from sprinkler heads could provide artificial showers whenever desired. This provision was suggested to control relative humidity and to reduce dust.

Within the main building there were to be streets, alleys, gardens, individual homes, and conventional apartment buildings. These interior structures were to be built after the manner of houses in tropical countries, for privacy but not for resisting heat transfer. The overhead sprinkler system would permit growing grass, trees, and flowers and would provide splendid fire protection. The heat losses through the enclosing structure expressed in direct steam radiation were 800,000 sq ft and the coal consumption at 70 lb per season per sq ft of radiation would be 28,000 tons.

Fuel Savings

If the area were occupied by ordinary seven story apartment buildings, with generous allowance for streets and playgrounds, there would be room for 16,000 apartments. If these apartments were outside, each would require about 250 sq ft of radiation, or a total of 4,000,000 sq ft. Coal consumption would be 140,000 tons, or 112,000 tons per year more than required for the enclosing structure.

If the enclosed area were to be reserved for detached homes, there could be accommodated 15,000 people in about 2200 houses. If these homes were outside, they each would require about 600 sq ft of steam radiation (1,320,000 sq ft total) and would burn 46,200 tons of coal per season, or 18,200 tons more than would be required for keeping them all warm inside the enclosing structure.

I suggested that there would be other substantial savings, such as in the reduced cost of the materials for the uninsulated interior buildings and in the reduced cost of labor in constructing them, since work would not be interrupted by storms or cold weather. There would be no expense for protection against freezing of pipes and storm sewers would not have to care for cloudbursts. There would be no

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costs for snow removal from sidewalks or streets.

People would not need to wear heavy clothing unless they wished to go outside the main building. Health would be improved by elimination of weather hazards and by control of dust. In 1922, I ventured to show that the savings in cost of fuel by reduction in area exposed to heat transfer plus these other reductions in cost would make the venture profitable.

The paper was rejected for publication by the engineering society, probably as being too radical for a serious body, but was released by the society without endorsement to the newspapers. It was snapped up by a general scientific magazine and by the Sunday papers, and I heard from it even by way of the Paris edition of an English newspaper.

Why Repeat the Tale?

I repeat the gist of this tale now because of many successfully heated manufacturing buildings of commensurate size occupied during the war, and still in use. Inside these buildings there are many sheds and office enclosures and people could live comfortably in them. I repeat the tale after ample observation of the thousands of miserable hutments clustered around our great universities, where the boys who fought for us eke out a miserable existence with their little new families, while wading through snow and water to bring home food and to acquire a deferred education.

I think of these boys trying to acquire enough fuel oil to keep a few gallons reserve in the little tanks on sawbucks outside their doors.

I repeat the tale also as I see the miles of alleged modern slum clearance projects—many of them cheaply built, ugly in appearance, and designed to present the greatest possible area of heat-losing surface.

I suggest that there will be sense in reducing the area of exposure to heat loss in our buildings as fuel becomes more costly. I suggest that if putting fins on a tube to increase heat transfer is good, then the converse—reducing skin surface of buildings to reduce heat transfer—also is good.

LITTLE EVIDENCE OF CONSTRUCTION SLOWDOWN

In a discussion of housing in 1948 at the annual convention of the Oil-Heat Institute last month, Thomas S. Holden, president of the F. W. Dodge Corp., said that "our estimates indicate for this year an overall increase over 1947 of 7 percent in dollar volume of building and engineering contracts. Within the overall 7 percent increase, we expect the dollar volume of nonresidential building contracts to increase 9 percent, residential contracts to increase 4 percent, heavy engineering contracts to increase 7 percent."

While these estimates are given in definite figures, they are to be considered as general approximations, he said. Dollar volume increases of these moderate proportions would probably mean little or no increase in physical volume, unless unit costs decline during the course of the year, he pointed out. A modest 3 percent increase in housing starts over 1947 is estimated.

These estimates presuppose a slowing down of the current construction boom, perhaps during this second quarter, perhaps a little later. If this takes place, total construction contract volume of the first half of 1948 will be greater than the contract volume of the first half of 1947, and contract volume of the second half would fall behind the second half of last year. We would expect the decline, if it comes, to be moderate, Mr. Holden stated.

"While we believe the odds favor such a slowdown in the present boom, on the basis of our analysis of overall economic factors, little evidence of slowdown has as yet appeared in the statistical records of construction starts," he said.

'47 CONSTRUCTION DOUBLED WARTIME LOW

Total physical volume of new construction in 1947 more than doubled the wartime low of 1944 and exceeded by 8 percent the total for 1939, the last year unaffected by war demand, Melvin H. Baker, chairman of the Construction Industry Advisory Committee, announced recently. "Moreover, the trend so far this year is well above the 1947 performance," he said.

"Using the estimates of the U.S. Department of Commerce for the volume of construction activity measured in constant dollars, the index of physical volume for 1939 is 100. In 1944 the index dropped to 50, climbed back to only 54.5 in 1945, and by 1947 had reached an estimated 107.6.

"This record demonstrates the efficiency and resourcefulness of the building industry and is a striking example of rapid recovery from the severe curtailment and dislocation of wartime conditions and postwar controls," according to Mr. Baker.

"While the emphasis necessarily continued to be placed on residential construction last year, with a near-record volume of housing starts, a large volume of other construction was under way and was apparent throughout the country in new stores, factories, schools, and hospitals of modern design. It should be remembered also, that in addition to new construction of all types, the industry was at the same time meeting an abnormal, record-breaking demand for farm building and repair and maintenance work.

"An outstanding record has been made in construction of new industrial plants needed to meet unprecedented postwar demands for goods. As early as 1946, the physical volume of new industrial building had climbed to within 2 percent of the alltime high attained in 1929 and was more than 700 percent above the wartime low reached in 1943," Mr. Baker stated.

CORROSION EXPERTS GET AWARDS

Two eminent research authorities, Dr. Ulick R. Evans and Dr. John M. Pearson, have been named recipients of the 1948 awards of the National Association of Corrosion Engineers. Dr. Evans was honored in recognition of his outstanding contributions to the fundamental knowledge on which the practical control of corrosion is based, and Dr. Pearson's award was for his outstanding service in the application of scientific research in the prevention of corrosion.

DATA SHEET

Simplified Procedure for SPECIFICATION WRITING

To MEET a number of requests from readers for more information about the method described in George W. Campbell's article, A Simplified Procedure for Specification Writing, in the April 1946 HPAC, it was decided to run as a supplement to this article a series of specification cards which are used by the firm of Urdahl and Everetts, consulting engineers, in their Washington, D. C., and San Francisco offices. Mr. Campbell is employed in the Washington office.

These cards have been published in consecutive issues starting in June 1947 and are concluded this month. Details of their use have been explained during their publication. These specifications are not to be construed as recommendations to other consultants but to illustrate this card file used by Urdahl and Everetts.

Card No. 76
Job No. ___

RADIANT HEATING PANELS: Panels shall be of the size and arrangement shown on the plans. The pipe and tubing shall be bent on a diameter not less than 12 times the nominal diameter. Any section of piping and tubing showing evidence of flattening or splitting shall not be repaired but shall be removed from the panel. No threaded joints will be permitted in concealed mains, branches or panels. Spacing will be as shown on the plans for each panel.

Panels will be constructed as follows:

Location	dia.	material (See PIPING)
Floors	3/4 "	Copper Water tube, steel pipe, wrought iron pipe
Walls	1/2" oval	Copper Water tube, steel pipe, wrought iron pipe
Ceiling	1/2" oval	Copper Water tube, steel pipe, wrought iron pipe

Floor Panels: A concrete sub-floor will be constructed by others at the desired grade as specified by this contractor. The panel will be secured to this floor in such a manner that the piping will not shift when covered. The piping will be covered by concrete or two inches to the top of the pipe. A wood floor consisting of wood sleepers to a depth at the thinnest point of approximately wood sub-floor and wood finish floor.

(over)

Card No. 77
Job No. ___

(Radiant Panel Heating System)

CONTROLS: A controller shall operate a three-way mixing valve in conjunction with an outdoor compensating temperature controller of the remote bulb type to maintain predetermined temperatures of water to the heating panels depending on the outside air temperature. This controller must be able to vary the water temperature from 65 F to 140 F when the outside temperature changes from 65 F to 0 F. The controller shall be provided with a manually operated device which for unusual temperature conditions will permit the system to be operated at a water temperature either above or below that which is considered normal for the existing outdoor temperature. This device shall have an effect on the water temperature of plus or minus 15 percent of the operating range of the water temperature controller.

When the outside temperature is below 65 F, the controller or auxiliary switch will keep the water circulator in continuous operation.

A room thermostat, located where shown on the plans, , shall be provided which will increase or decrease the effect of the outdoor controller in order to balance out the effect of varying indoor loads. This thermostat shall be of the proportioning type having a range from 62 F to 87 F with a differential of 2 F and a locking type adjustment. It shall be set for F. This thermostat shall be capable of varying the heat input plus or minus 5 percent of the demand indicated by the outdoor compensator.

(over)

Card No. 78
Job No. ___

ACCESS PLATES AND DOORS: Access Plates - Provide where shown on the plans access plates (AP) of the size shown below. The plates will be secured to the duct by means of fastener. The perimeter of the AP shall be turned back on itself 1/4 in. A 1/2 in. wide sponge rubber felt gasket shall be provided and securely fastened to duct. Fan AP may just be a flat plate. Plates shall be two gage heavier than the duct in which located except for Fan AP which will be of the same gage as the fan housing.

Ducts 24 in. x 36 in. and larger. Spacing- 75 ft on centers and/or each section isolated by turning vanes, elbows, dampers which restrict duct below 24 in. x 24 in., coils, fans, etc.

AP-A 20 in. x 36 in. (When in bottom or top of duct).
AP-B 14 in. x 20 in. (When in side of duct).

Ducts smaller than 24 in. x 36 in. , Spacing- 20 ft on centers for straight run ducts and/or each section isolated by dampers, coils, fans, etc.

(over)

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Card No. 78 cont.
Job No. ___

AP-C 12 in. x 24 in. (When in bottom or top of duct).
AP-D 6 in. x 16 in. (When in side of duct).

Fans, Radial Flow. When fans are bottom horizontal discharge, AP may be located in the discharge duct adjacent to the fan. Fans which circulate grease-laden air will have AP regardless of blade spacing. AP should be located at an accessible point as close to the bottom as practical.

Wheel dia. less than ___ 48 in. with less than 2 in. between blades.

AP-F 12 in. x 12 in.

Wheel dia. 48 in. and greater

AP-G 14 in. x 20 in.

Access Doors: AD will be hinged having ___ 4 in. _____ strap hinges and using window sash fasteners as catches. All doors shall have a two diagonal cross-break.

AD-A 20 in. x 36 in. _____ 20 gage
AD-B 20 in. x 42 in. _____ 20 gage

Card No. 77 cont.
Job No. ___

A predetermined boiler water temperature of ___ 160 F shall be maintained by an immersion type thermostat having a range from ___ 60 F to 220 F with a differential of ___ 10 F which will operate the oil burner gas burner stoker.

A "summer-winter" switch will be provided which will function as follows: Summer, - operate the burner to maintain water temperature as determined by immersion type thermostat setting. No other equipment to operate; Winter, - operate all equipment as specified to heat structure.

An "emergency" (OFF-ON) switch will be provided which will cut off all electrically operated heating equipment.

Card No. 76 cont.
Job No. ___

: Piping will be placed directly on _____ _____ gravel metal wood saddles as shown on the plans after which _____ ___" concrete floor will be poured constructed over the panel piping.

: Paneling will be constructed as shown on the drawings.

Mains and branches will be run in the gravel fill. _____ _____.

Wall Panels: After the erection of the metal lath and/or plaster board, the piping will be securely fastened to that surface. The wall will then be plastered in the conventional manner. When metal lath is used, it is the responsibility of this contractor to see that the plaster is forced through the lath to completely cover the back part of the pipe.

: Wood _____ studs will be drilled or notched to permit the piping to be run horizontal. The plaster and plaster board and/or metal lath will be placed on both _____ sides of the studs in the conventional manner. The piping must not be in contact with the plaster board and/or metal lath. Insulation will be placed between the piping and the plaster board and/or metal lath of the wall of the adjacent room.

Card No. 76 cont
Job No. ___

Ceiling Panels: After the erection of the metal lath and/or plaster board, the piping will be securely fastened to that surface. The ceiling will then be plastered in the conventional manner. When metal lath is used, it is the responsibility of this contractor to see that plaster is forced through the lath to completely cover the back part of the pipe.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Ground Temperature Distribution With a Floor Panel Heating System

By A. B. Algren*, Minneapolis, Minn.

SUMMARY—Heat losses through floor slabs together with perimeter losses are of major importance in floor panel heating of basementless houses. Ground temperature data reported were obtained from a field test on a research residence under actual operating conditions and indicate that floor panels on the ground should include materials of insulating value.

ALTHOUGH many articles have been published describing floor panel heating systems, there appears to be a lack of factual data which would be of assistance to the design engineer.

This paper describes the construction and test equipment of a basementless research residence heated by a warm air floor panel heating system and located at Edina, Minn. There were 98 thermocouples installed at various locations within the residence, in the ground beneath the concrete floor slab, and in the ground at distances of approximately 60 and 1200 ft from the residence.

The entire research project has been coordinated with the Panel Research Program of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS and will provide test data and results on ground temperature distribution, heat losses to the ground, heat losses through concrete footing walls, heat losses around the perimeter of the concrete slab, inside air temperature distribution, temperature distribution across the surface of the panel, and methods of control for floor panel heating systems.

The test program is to cover approximately a two-year period. During this time test data will be reported showing results for approximately one year of normal occupancy and for a nine-month period during which time the residence will be unoccupied but maintained at an inside air temperature of 70 F throughout the time that heat would be required.

Residence Construction

The research residence is of the flat roof type, has no basement, and is heated by means of a floor panel forced warm air heating system. The wall construction consists of two 4-in. dry-tamped concrete walls enclosing a 2½ in. space filled with insulation. Inside finish consists of a vapor resistant membrane and plaster bond applied directly to the inside concrete surface, and covered with gypsum plaster. The exterior finish consists of a pneumatically applied flash coat of white sand and cement. The footing walls extend below the frost line.

The roof and ceiling are of standard wood frame construction with 2 in. by 6 in. joists spaced 16 in. on centers, with 4 in. of insulation between the joists. A vapor resistant membrane was applied to the warm side of the joists, with plaster base and plaster for the inside finish.

The floor construction consists of a vapor resistant membrane laid directly on the ground under a 9 in. washed gravel fill and flashed up the sides of the footing walls to approximately the finished floor level. A 4 in. concrete slab was poured over the gravel fill, and an air space varying from 4 to 6 in. in depth was provided by use of concrete curbing and columns for supporting a 2 in. thick reinforced concrete floor slab. An asphalt treated insulating board, 1 in. thick and 12 in. deep, was placed between the footing walls and the edge of the floor slab. The air space formed by two concrete slabs provides a duct system for circulating warm air. The proper air circulation and

*Associate Professor and Head of the Division of Heating, Ventilating and Air Conditioning, Mechanical Engineering Department, University of Minnesota. Member of ASHVE.
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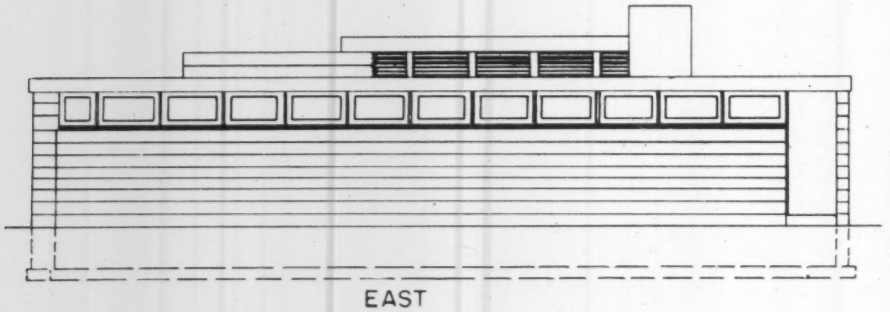
distribution for supplying heat to the floor panel has been provided by the engineered location of the concrete curbs under the finished floor. Supplemental heat and ventilation can be supplied to each room from the warm air plenum chamber under the finished floor through risers and high side wall registers.

Inasmuch as the research project includes a study of different control methods, the required wiring details were taken care of during construction. The control system now being used is operated by outdoor and indoor temperature and regulates both the room air temperature and the warm air heating medium. Other methods to be studied include the conventional thermostatic control and the electronic control systems.

The heating plant consists of a gas-fired, forced warm air furnace with top outlet and bottom return. Propane is used for fuel.

Fig. 1 shows the east and west elevations of the research residence. Both the south and west exposures of the living room contain large picture windows, the total glass area for the living room being 69 percent of the floor area. This design provides a means for studying the effect of solar radiation for both winter and summer operation. The high ribbon type windows as shown by the east elevation are continuous and carried around to a section of the south exposure. The total glass area for the residence is approximately 38 percent of the total floor area. As this percentage of glass area is seldom exceeded, the results obtained from this study should be of some assistance to the design engineer in providing information on the effect of large glass areas in residences employing floor panel heating. Insulating glass throughout the residence consists of double panes enclosing a ¼ in. hermetically sealed space containing dehydrated air.



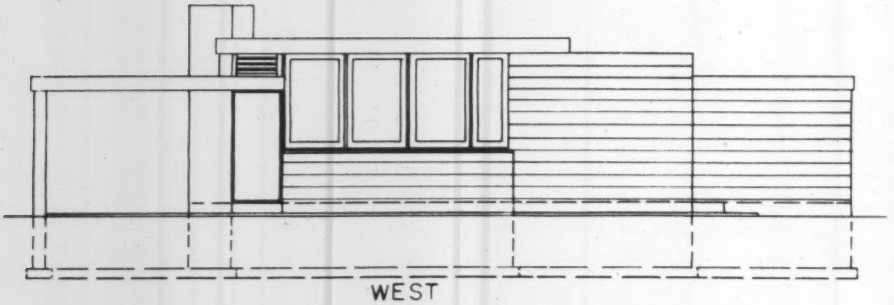


Fig. 1—Research Residence

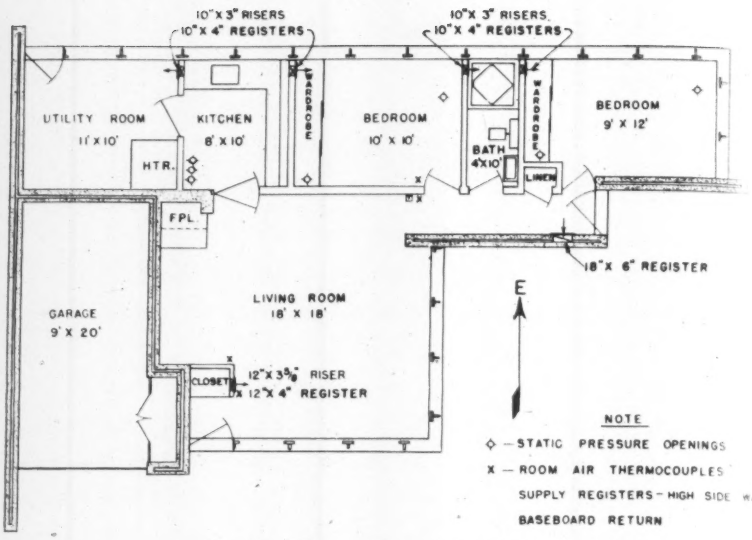


Fig. 2—Floor plan of Research Residence

The floor plan for the residence is shown in Fig. 2 which also indicates the location of: static pressure openings in the floor used for measuring the static pressure drop through the system and also through two of the room circuits; the thermocouple locations for measuring room air temperatures, air temperatures adjacent to the thermostat, and register outlet air temperature. Room air temperatures are read at points 3 in. above the floor, at the 5 ft level, and at 3 in. below the ceiling. The floor plan also shows the location of risers and registers used for supplying supplemental heat and ventilation to the various rooms. A single baseboard return as shown in the plan provides a means for returning room air to the furnace.

Fig. 3 shows the plan view of the air distribution system, together with a sectional view of the wall and floor construction.

Warm Air Distribution in Floor Panel

As the residence was designed primarily for the purpose of obtaining the public's reaction to functionalism in present home construction, it was decided to employ a forced warm air floor panel heating system and incorporate, in the design, methods of supplying both

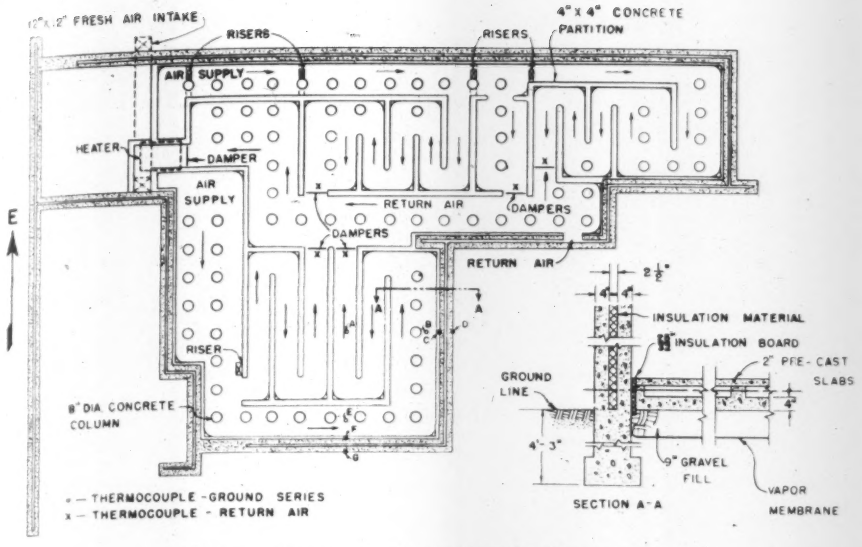


Fig. 3—Plan view of air distribution system

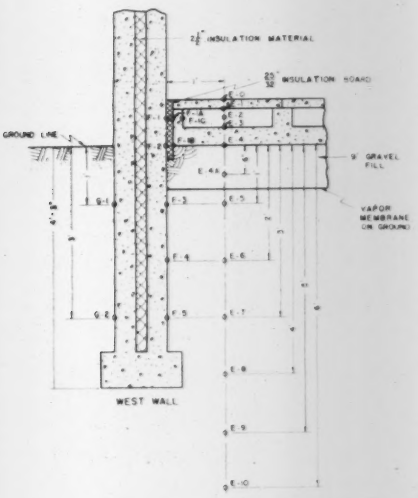


Fig. 5—Thermocouple locations, Series E, F, G

supplemental heat and ventilation by the use of a single system.

The location of the 4 in. concrete curbing previously mentioned is shown in the plan view of Fig. 3. It serves the dual purpose of giving directional flow to the heated air and, in conjunction with the 8 in. diameter concrete columns, assists in supporting the finished concrete floor.

Mass type dampers in the return circuit from each room provide means for volume control. Outside air for ventilation is supplied through the fresh air intake as shown in the figure. The locations of the ground series thermocouples are indicated by the letters A, B, C, D, E, F, and G in Fig. 3.

Results of tests on the supply and return air circuits, shown in Fig. 3, have provided data for simplifying the design and thereby reducing the static pressure loss for the system. The present design eliminates all dampers with the exception of the supply and return dampers at the furnace.

Thermocouple Location

Figs. 4, 5, and 6 show the thermocouples located within and below the panel, together with ground thermocouples situated 60 ft west and 1200 ft southeast of the residence. The temperatures recorded by the outside ground thermocouples are used as datum points in making an analysis of heat gain to the ground underneath the floor panel.

Fig. 4 shows a sectional construction detail of floor panel and footing wall, together with thermocouple locations for the south living room exposure. A solid concrete footing wall was used only for the south living room wall. All other footing walls were of the double wall construction with 2½ in. of insulation, as shown in Fig. 5. Insulated and uninsulated footing walls were used in order to determine not only the effect of insulating the footing wall but also its practicability from a construction viewpoint.

Fig. 6 shows the location of thermocouples in the center of the living room and also the two series of thermocouples located in the ground away from the residence. The thermocouples under the residence were carried to a depth of 6 ft and the ground datum thermocouples to a depth of 16 ft.

All of the thermocouples are 24 gage, copper-constantan wire and have been protected from ground moisture by encasing each thermo-

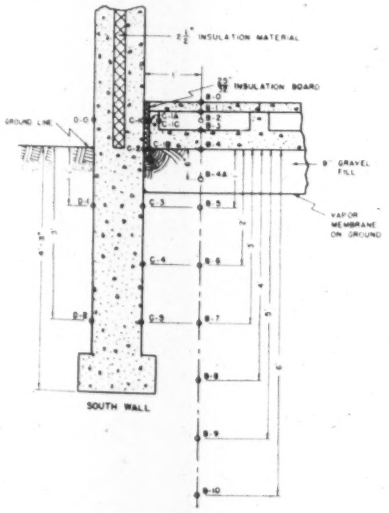


Fig. 4—Thermocouple locations, Series B, C, D

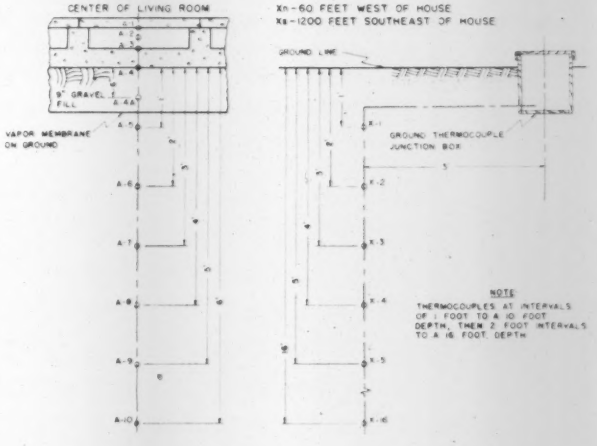

CENTER OF LIVING ROOM
Xn-60 FEET WEST OF HOUSE
Xs-1200 FEET SOUTHEAST OF HOUSE
GROUND LINE
9" GRAVEL FILL
VAPOR MEMBRANE ON GROUND
GROUND THERMOCOUPLE JUNCTION BOX
NOTE
THERMOCOUPLES AT INTERVALS OF 1 FOOT TO A 10 FOOT DEPTH, THEN 2 FOOT INTERVALS TO A 16 FOOT DEPTH

Fig. 6—Thermocouple locations, Series A, X

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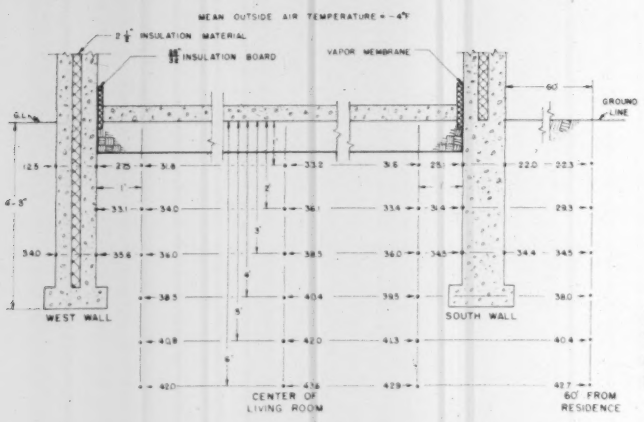

Fig. 7 *(Left)*—Temperature distribution below floor panel, Jan. 3, 1947

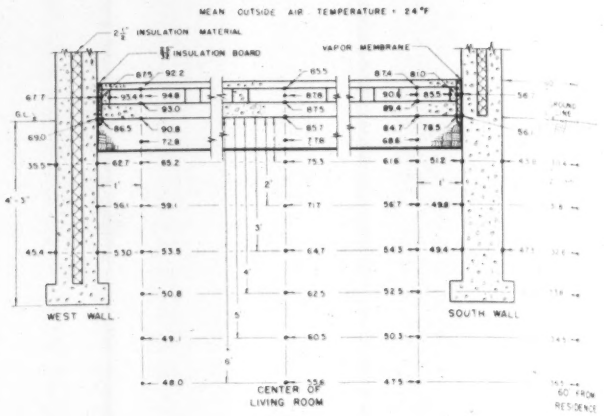

Fig. 8—Temperature distribution below floor panel, Mar. 26, 1947

couple in a thin wall rubber tubing sealed at the end.

Test Results

When the project was begun, plans were made for completing the residence by December 1, 1946. Due to material and labor shortages, the residence was not completed until February, 1947. Because of the delay in completing the residence, it was decided to take *weekly* readings of all the thermocouples for the balance of the heating season and to make a *continuous* record of the most important temperatures during the following heating season. From a study of the test data it was possible to select the residence and floor panel temperature locations which showed the quickest response to any variation in operating conditions. Automatic recorders have been installed for furnishing a continuous record of these temperatures for tests following those reported in this paper. All other temperature readings, together with a complete traverse of floor surface temperatures will be read weekly for subsequent tests. A report covering these test data will be published at the conclusion of the present heating season.

Fig. 7 presents ground temperatures for January 3, 1947, before the finished floor was in place but with the furnace in operation. During this period of operation the room air temperatures were miantained at approximately 60 F. The temperature data shown are given mainly for the purpose of indicating ground temperatures before construction was completed.

The temperatures shown in Fig. 8 give ground temperatures six weeks after the residence was completed and with the heating plant in operation. An analysis of these temperatures indicates that the heat loss around the perimeter of the floor panel, together with the heat gain to the ground under the slab, presents a loss that should be given consideration in all floor panel heating designs. This would also be true for all constructions where the floor slab is laid directly on the ground and other methods of heating are employed.

The desirability of insulating the perimeter of the floor panel is quite evident from the temperature drop across the insulation which is 19.8 deg for the west wall and 22.3 deg for the south wall. When the temperature drop across the insulation or construction is known, together with its conductivity or conductance, the loss in Btu per hour can be calculated by the following equation:

$$Q = AC(\Delta t)$$

where

Q = Btu loss per hour
A = area, square feet
C = conductance of material, Btu per (hour) (square foot) (F deg) (see Table 1)
Δt = temperature drop, F degrees

For the temperature drops as reported, and assuming an area of 1 sq ft, the heat loss through the perimeter insulation would amount to 10.1 Btu per (hr) (sq ft) for the west wall and 11.4 Btu per (hr) (sq ft) for the south wall. The difference can be attributed to the additional insulation in the west footing wall. Likewise, an analysis of the temperatures on each side of the footing walls at a distance of 1 ft below the ground level shows a temperature drop across the insulated footing wall of 27.2 deg as compared with 7.4 deg for the uninsulated footing wall. Expressed in terms of Btu, these values become 3.29 Btu per (hr) (sq ft) for the insulated footing wall and 8.43 Btu per (hr)

Table 1—Heat Losses Behind Panel (March 26, 1947)

Construction	Location	Conductance of Material or Section Btu per (hr) (sq ft) (F deg per ft)	Temperature Drop F Deg	Btu Loss per (hr) (sq ft)
25/32 in. Insulating Board	West wall perimeter	0.512	19.8	10.1
25/32 in. Insulating Board	South wall perimeter	0.512	22.3	11.4
2½ in. Insulation—2 4 in. Concrete walls	West wall—1 ft below ground level	0.121	27.2	3.29
10½ in. Concrete footing wall	South wall—1 ft below ground level	1.14	7.4	8.43
2½ in. Insulation—2 4 in. Concrete walls	West wall—3 ft below ground level	0.121	7.6	0.92
10½ in. Concrete footing wall	South wall—3 ft below ground level	1.14	2.1	2.4
4 in. Concrete slab	1 ft from west wall	3.00	2.2	6.60
4 in. Concrete slab	1 ft from south wall	3.00	4.7	14.1
4 in. Concrete slab	Center of slab	3.00	1.8	5.40

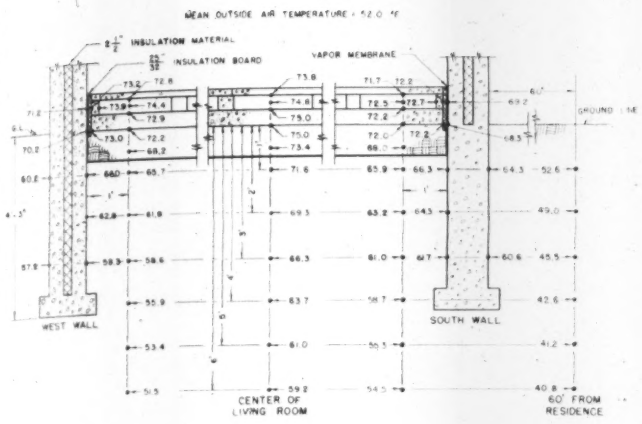

Fig. 9 — *(Left)* Temperature distribution below floor panel, May 13, 1947

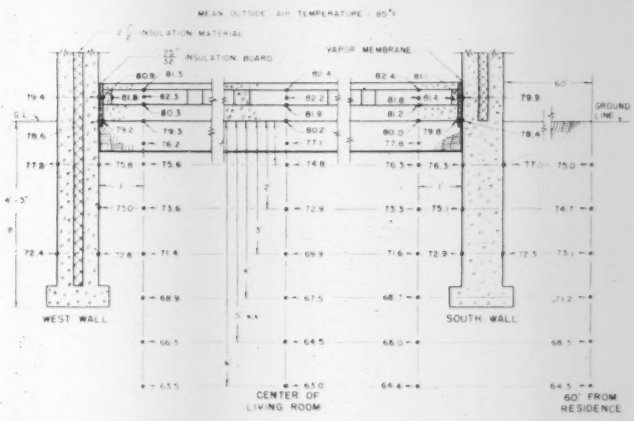

Fig. 10—Temperature distribution below floor panel, Aug. 21, 1947

(sq ft) for the uninsulated footing wall.

This same relationship exists also at the 3 ft depth where temperature drops were 7.6 deg and 2.1 deg with a corresponding Btu loss of 0.92 Btu per (hr) (sq ft) for the insulated footing wall and 2.40 Btu per (hr) (sq ft) for the uninsulated footing wall.

The effect of heat storage is indicated by a comparison of the ground temperatures of Fig. 7 with those of Fig. 8. At the 1 ft and the 6 ft levels, it will be noted that the ground temperatures below the center of the living room have increased from 33.2 to 75.3 F and from 43.6 to 55.6 F, respectively. A further analysis of the temperature drop across the 4 in. concrete slab again indicates the effect of the insulated footing wall on reducing the heat losses around the perimeter of the slab. At a distance of 1 ft from the west wall the temperature drop across the 4 in. concrete slab is 2.2 deg and at a distance of 1 ft from the south wall it is 4.7 deg, as shown in Fig. 8. Expressed in terms of Btu, this would be approximately 6.6 Btu per (hr) (sq ft) for the west exposure with an insulated footing wall and 14.1 Btu per (hr) (sq ft) for the south exposure with an uninsulated footing wall.

These losses indicate paths of high heat conductivity along the perimeter of the slab as they allow the heat to flow through the 4 in. concrete slab around the end of the rigid insulating board and through the concrete footing wall. This effect is clearly indicated by studying the ground isotherms, as shown in Fig. 11. If the rigid insulating board were extended to a depth of 2 ft below the ground level or at least below the fill, the heat loss at this section would be materially reduced.

The temperature distribution as shown in Fig. 8 also indicates that the maximum heat storage occurs in the ground under the center of the slab and decreases to a minimum at the perimeter of the slab. At the center of the slab the temperature drop across the 4 in. of concrete is 1.8 deg and, expressed in terms of Btu, amounts to 5.4 Btu per hour per square foot. Table 1 gives a summary of the losses as discussed.

Fig. 9 shows temperatures for May 13 and, as would be expected, the temperature differences decrease as the outside air temperature increases. By an analysis of the test data as shown in Figs. 8 and 9 it is evident that in the design of floor panel heating systems the heat losses through the floor construction and footing walls present a greater problem in areas where sub-zero temperatures exist than in those of more moderate climates.

Summer Ground Temperatures

Weekly temperature readings were taken throughout the summer; Fig. 10 shows the ground temperatures for August 21, 1947. It will be noted that the ground temperatures under the center of the concrete slab increases approximately 3 deg at all temperature points down to a 6 ft depth. These temperatures are consistently lower than temperatures at corresponding levels at the footing walls and also at the level 60 ft from the residence. As would be expected, insulating the footing wall has very little effect on the ground temperatures during this relatively short summer cycle.

Figs. 7, 8, 9, and 10 are shown primarily for the purpose of presenting test data, and they indicate the temperatures that existed on the day the readings were taken. Figs. 11, 12, 13, and 14 show average ground isotherms for various periods from the time the test was begun up to and including October 28, 1947. The ground isotherms, as shown in these figures, are plotted from the average of all readings taken during the test period as indicated.

With reference to Fig. 11, the major heat losses occur through the uninsulated south footing wall at a point near the lower edge of the 25/32 in. insulating board at the perimeter of the slab. The isotherms from 54 to 70 F inclusive converge at this point in the south footing

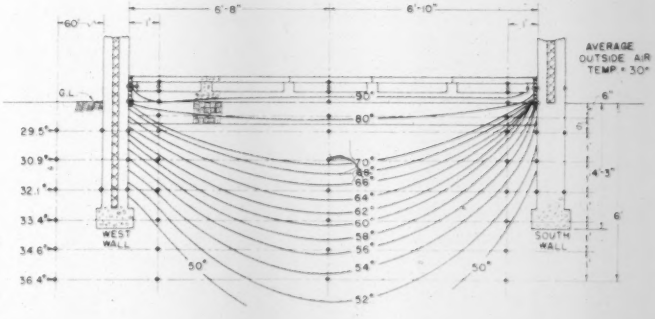

Fig. 11—Average ground isotherms, Mar. 4 to Apr. 1, 1947

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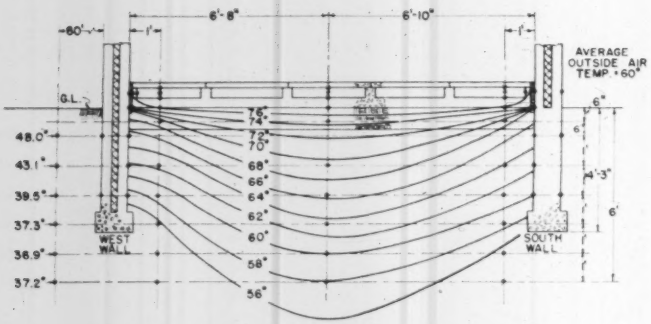

Fig. 12—Average ground isotherms, Apr. 29 to May 13, 1947

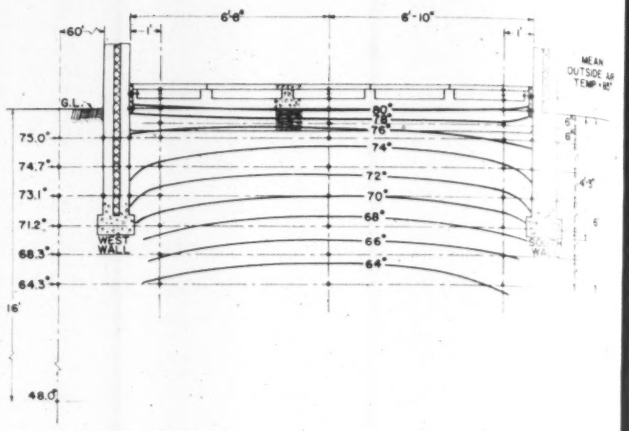

Fig. 13—Ground isotherms, Aug. 21, 1947

wall but are fairly uniformly distributed as to depth in the west footing wall. Tracing the 54 F isotherm, it can be noted that it extends from the 6 in. depth at the south footing wall to approximately the 6 ft depth at the center of the room to the 2 ft 4 in. depth at the west footing wall. The value of insulation is quite apparent.

In Fig. 12 the isotherms appear to be approaching a phase relationship due to the change in the surrounding ground temperatures. The average outside air temperature for this period was found to be 60 F, while for Fig. 11 it was 30 F. This resulted in an increase in the surrounding ground temperature with the highest now being at the 1 ft depth and the lowest at the 6 ft depth. The rapid change indicates that the conductivity of the soil is high and does not offer much resistance to heat flow.

The ground isotherms of Fig. 13 show conditions near the end of a prolonged hot spell during which time the maximum outside air temperature reached 102 F. The direction of the isotherms is reversed which indicates that the ground temperatures under the concrete slab are lower than the ground temperature adacent to the footing walls at the same level. Also starting at the 1 ft level and continuing down to the 6 ft level, it will be noted that the ground temperatures under the center of the concrete slab are consistently lower than the ground temperatures at the corresponding level 60 ft from the residence. Likewise, the ground temperature under the center of the room and at the 6 ft level increased from 58 F, as shown in Fig. 12, to approximately 61.5 F. This temperature rise indicates a heat storage during the summer season and would result in a decrease in heat loss through the ground slab at least during the beginning of the next heating season. The effect of the insulated footing wall as compared with the uninsulated footing wall appears to be negligible for the summer period.

The isotherms of Fig. 14 are plotted for the beginning of the present heating season and show the same trends as the isotherms of Figs. 11 and 12.

Effect of Moisture in Soil

A factor of major importance when calculating heat losses to the ground is the initial moisture content of the soil and the moisture migration over several heating seasons. In order to determine if any variation in ground conditions occurs from one heating season to another, soil tests were made before the floor panel was laid. Field tests were made to determine the moisture content of the soil. Laboratory tests were made on an average sample of the soil collected at depths of from 1 to 3 ft. In order to obtain representative results, approximately 200 lb of soil were used for testing. Test results are reported in Table 2.

Results of a number of tests conducted on different soils at the Engineering Experiment Station, University of Minnesota, show that an increase of 1 lb in density increases the conductivity by approximately 2½ percent. Applying this correction to the test results of Table 3 values of k for the soil at 115 lb per cubic foot density and 23 percent moisture content would be 17.22 Btu per (hr) (sq ft) F deg per in. at a mean temperature of 70 F.

Table 2—Test Report on Soil Sample[a]

Mechanical Analysis
Silt = 54.6%; Clay = 16.4%; Sand = 29.0%
Physical Constants
Moisture, Field Condition = 23%; Density (dry basis) = 115 lb per (cu ft)

[a]Tests conducted by Professor Miles S. Kersten of the Engineering Experiment Station, University of Minnesota.

Table 3—Results of Conductivity Tests

Test No.	Density Lb/cu ft	Moisture Percent	Mean Temperature F	k Btu/sq ft/hr F in.
1	82.6	1.23	70.0	1.72
2	93.0	1.23	70.3	2.23
3	93.0	1.23	40.1	2.16
4	93.0	1.23	24.9	2.14
5	93.0	1.23	—19.9	2.15
6	92.4	16.70	70.1	9.14
7	92.4	16.70	40.1	8.78
8	92.4	16.70	25.1	11.17
9	92.4	16.70	—19.9	10.97
10	92.4	23.0	70.0	11.0
Calculated	115.0	23.0	70.0	17.22

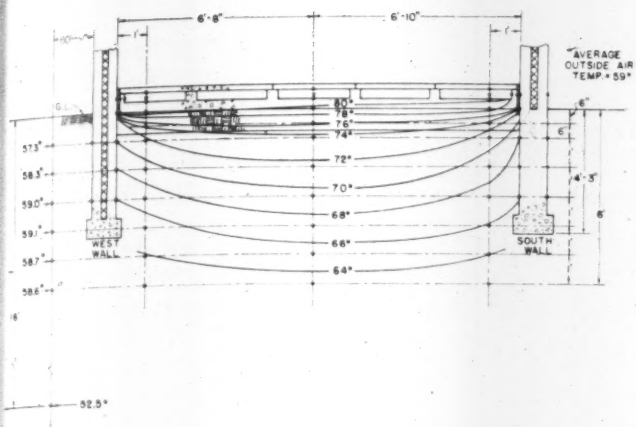

Fig. 14—Average ground isotherms, Oct. 7 to Oct. 28, 1947

Although the ground isotherms given in Figs. 11 to 14 inclusive show where the major heat losses occur in floor panel construction, they do not readily present means for making an analysis of any physical changes that occur in the soil under the concrete slab.

In order to make this analysis, the test data with respect to the Series A thermocouples for the periods of February 18 to April 22, 1947 and October 7 to December 18, 1947 were selected and are shown in Tables 4 and 5, respectively. Temperatures at the various locations can be determined by referring to Figs. 4, 5, and 6. As the effect of slab perimeter and footing wall losses decreases as the distance away from the points increases, Series A thermocouples would be the least affected. The ground isotherms of Figs. 11 to 14 inclusive indicate that the horizontal temperature drop through this section is relatively small.

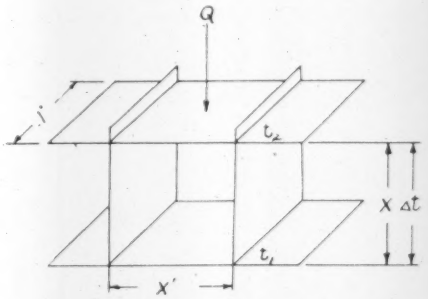

Fig. 15—Graphical solution for heat conductivity of soil

In order to make a graphical analysis of heat flow, it was necessary to assume steady flow conditions and also that the lines of heat flow are perpendicular to the isotherms.

The section under the center of the concrete slab and between the 1 and 2 ft levels was selected for this study.

An analysis of the test data shows a temperature drop of 2.0 deg (Table 4) and a drop of 1.5 deg (Table 5) through the 4 in. concrete slab. These temperature drops would be affected by the temperature of the heating medium which was 87.8 F and 87.1 F, respectively.

With a conductivity value k of 12.0 for the concrete, the heat loss through the slab at the selected section would be $2.0 \times \frac{12.0}{4} = 6.0$ Btu per (hr) (sq ft) and $1.5 \times \frac{12.0}{4} = 4.5$ Btu per (hr) (sq ft), respectively. Assuming these values to represent the quantity of heat flowing through the gravel fill and the soil and using the following graphical solution (see Fig. 15), the conduc-

Table 4—Test Data for Series A Thermocouples for the Period February 18 to April 22, 1947. Average Indoor Temperature, 74.0 F

Date	Thermocouple Designation										
	A-1	A-2	A-3	A-4	A-4a	A-5	A-6	A-7	A-8	A-9	A-10
February 18	81.0	87.0	84.5	81.0	66.8	58.3	50.6	45.2	44.8	44.0	42.8
February 21	83.2	87.0	84.8	81.7	72.4	66.8	57.5	51.0	47.3	45.2	44.4
February 25	84.0	84.7	83.0	82.7	76.2	72.5	64.0	54.7	48.8	45.8	44.5
March 4	93.3	93.4	94.8	93.2	83.8	80.2	72.3	65.2	57.3	52.3	49.6
March 17	98.3	99.4	97.9	94.8	82.6	78.1	70.5	64.7	59.7	55.6	53.3
March 26	85.5	87.8	87.5	85.7	77.8	75.3	71.7	64.7	62.5	60.5	55.6
April 1	82.7	84.6	84.2	82.3	78.0	75.3	71.4	66.9	63.5	59.5	55.3
April 15	80.7	81.6	81.2	80.8	77.9	75.0	71.3	67.7	64.9	60.9	57.0
April 22	83.6	84.7	84.3	81.3	76.2	73.1	69.5	66.2	63.0	60.0	55.3
Average	—	87.8	86.81	84.83	—	72.73	66.53	—	—	—	—

Table 5—Test Data for Series A Thermocouples for the Period October 7 to December 18, 1947. Average Indoor Temperature, 75.5 F

Date	Thermocouple Designation										
	A-1	A-2	A-3	A-4	A-4a	A-5	A-6	A-7	A-8	A-9	A-10
October 7	82.5	80.2	79.0	77.3	74.5	73.6	71.8	69.8	67.6	65.6	63.1
October 14	80.5	80.5	79.8	77.9	75.2	73.5	71.2	69.3	67.5	65.6	62.7
October 24	83.2	83.5	83.0	82.0	77.0	73.8	71.3	69.1	67.2	65.0	63.5
October 28	85.4	84.0	82.5	81.5	77.1	74.6	72.1	69.2	67.0	65.0	63.0
November 4	83.2	83.8	82.8	81.0	78.0	75.7	73.4	70.4	68.0	65.7	63.2
November 11	84.8	85.5	86.1	85.2	80.2	77.1	74.1	71.0	68.8	66.4	63.6
November 18	86.0	87.0	87.4	85.8	81.0	77.6	75.0	71.8	69.4	66.9	63.5
November 25	87.6	87.8	88.6	87.0	83.4	79.7	76.2	72.3	69.0	66.1	63.7
December 2	88.6	89.0	89.9	89.3	84.6	81.4	78.0	73.9	70.4	67.3	64.3
December 9[a]	100.4	102.0	101.0	98.8	88.9	82.8	78.3	74.5	70.8	67.3	63.8
December 18	95.4	96.1	96.2	94.5	86.5	82.2	78.6	74.9	71.0	67.7	64.9
Average	—	—	86.94	85.48	—	77.46	74.55	—	—	—	—

[a]Outdoor temperature on December 9: —12 F.

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tivity of the soil can be calculated as follows:

let,

Q = Quantity of heat flowing, Btu per hour (assumed to be the same as that flowing through the concrete slab).
t_1 = temperature of ground isotherm at 1-ft level.
t_2 = temperature of ground isotherm at 2-ft level.
x = distance in inches between isotherms (12 in.).
x' = distance in feet and equal to x by construction.

then,

$Q = AC\Delta t$

$Q = (1 \times x')\frac{k}{x}\Delta t$

$Q = 1 \times \frac{k}{12}\Delta t$ = amount of heat flowing through channel 1 ft square and 12 in. in depth.

where

Q = heat flowing, Btu per hour.
C = conductance of material, Btu per (hour) (square foot) (F deg) $= \frac{k}{x}$
k = conductivity of material, Btu per (hour) (square foot) (F deg per inch).
x = thickness or depth of material, inches.
Δt = temperature difference $(t_1 - t_2)$.

From test data (Table 4), A-5 and A-6:

$t_1 = 72.7$
$t_2 = 66.5$
$Q = 6.0$ (by previous calculation)
$6.0 = 1 \times \frac{k}{12}(72.7 - 66.5)$
$k = 12$ Btu per (hour) (square foot) (F deg per inch)

From test data (Table 5), A-5 and A-6:

$t_1 = 77.5$
$t_2 = 74.6$
$Q = 4.5$
$4.5 = 1 \times \frac{k}{12}(77.5 - 74.5)$
$k = 18$ Btu per (hour) (square foot) (F deg per inch)

Because the ground froze before the floor panel was constructed, it was necessary to thaw out the ground before the concrete slab was poured. The application of heat and the contact of the ground with relatively dry air not only thawed out the soil but also reduced its moisture content as indicated by the decreased value of k based on the test data of Table 4. The value of k calculated from the test data of Table 5 is in agreement with the value of k determined by test. This would indicate that if the moisture content of the soil were decreased during the heating season, the moisture gain during the summer would tend to maintain a constant moisture content for the beginning of each heating season. The test results covering the present heating season should provide additional information for checking this conclusion.

Complete test data showing ground and slab temperatures for March 4, 1947 and December 18, 1947 are shown in Tables 6 and 7, respectively. An analysis of this test data also indicates an increase in

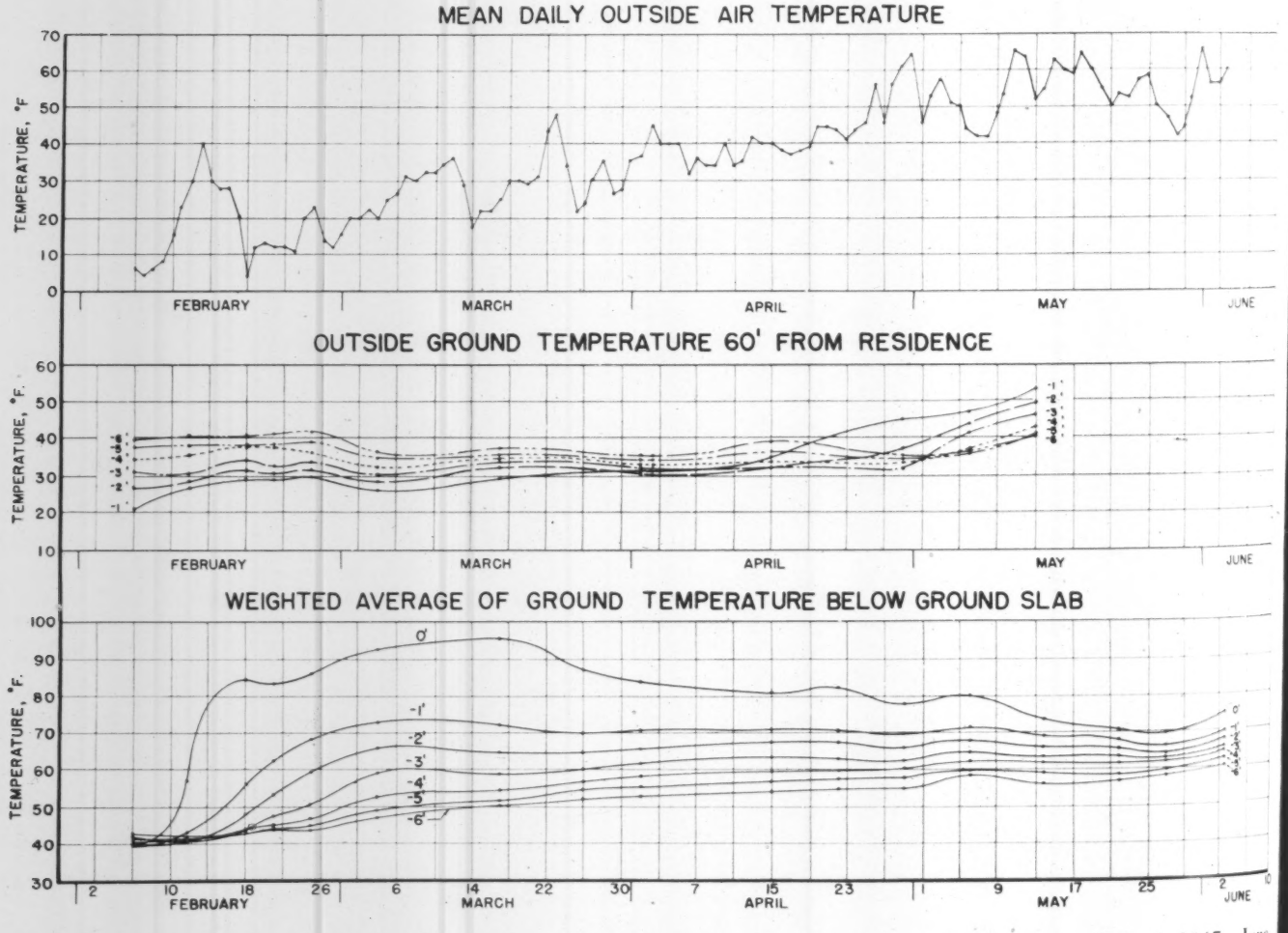

Fig. 16—Curves showing the relationship between ground temperatures and outside air temperatures (Feb. 6, 1947—June 3, 1947)

Table 6—Ground and Slab Temperatures on Mar. 4, 1947

(Mean Outdoor Temperature 20 F; Average Indoor Temperature 75 F)

A-1	93.3	B-6	56.5	E-1	110.8	F-4	56.3
A-2	93.4	B-7	52.4	E-2	111.3	F-5	48.8
A-3	94.8	B-8	48.8	E-3	103.1		
A-4	92.2	B-9	45.7	E-4	96.4	G-1	29.2
A-4a	83.8	B-10	45.0	E-4a	78.4	G-2	39.4
A-5	80.2			E-5	70.2		
A-6	72.3	C-1	62.2	E-6	61.8	X-1n	26.9
A-7	65.2	C-1a	89.3	E-7	54.7	X-2n	28.2
A-8	57.3	C-1b	82.8	E-8	49.6	X-3n	30.5
A-9	52.3	C-1c	94.7	E-9	46.5	X-4n	32.5
A-10	49.6	C-2	59.3	E-10	45.2	X-5n	34.8
		C-3	51.6	F-1	69.6	X-6n	35.5
B-1	101.8	C-4	49.6	F-1a	84.3	X-7n	—
B-2	108.6	C-5	47.8	F-1b	87.8	X-8n	—
B-3	99.5			F-1c	103.4	X-9n	—
B-4	91.2			F-2	70.3	X-10n	—
B-4a	70.6	D-1	42.3	F-3	64.4	X-12n	—
B-5	63.8	D-2	43.3				

Table 7—Ground and Slab Temperatures on Dec. 18, 1947

(Mean Outdoor Temperature 15 F; Average Indoor Temperature 75.5 F)

A-1	95.4	B-6	65.6	E-1	99.4	F-4	63.6
A-2	96.1	B-7	63.7	E-2	103.0	F-5	58.8
A-3	96.2	B-8	62.0	E-3	103.2	G-1	39.5
A-4	94.5	B-9	60.5	E-4	100.0	G-2	51.4
A-4a	86.5	B-10	58.8	E-4a	81.8		
A-5	83.2			E-5	74.5	X-1n	35.3
A-6	78.6	C-1	63.9	E-6	68.3	X-2n	38.0
A-7	74.9	C-1a	89.0	E-7	63.0	X-3n	40.2
A-8	71.0	C-1b	86.0	E-8	61.0	X-4n	42.4
A-9	67.7	C-1c	93.9	E-9	59.8	X-5n	44.7
A-10	64.9	C-2	62.0	E-10	58.9	X-6n	46.7
		C-3	57.5	F-1	71.8	X-7n	48.3
B-1	98.5	C-4	58.0	F-1a	91.8	X-8n	49.8
B-2	100.1	C-5	58.4	F-1b	90.1	X-9n	50.7
B-3	99.0			F-1c	96.0	X-10n	51.5
B-4	94.9			F-2	74.0	X-12n	52.7
B-4a	78.0	D-1	50.0	F-3	68.0	X-14n	53.3
B-5	70.0	D-2	55.5			X-16n	53.7

moisture content and conductivity during the summer season.

The curves in Fig. 16 show the relationship between ground temperatures 60 ft from the residence, average ground temperature below the concrete slab, and the mean daily outside air temperature. Any sudden changes in temperature have very little effect on ground temperatures below the 1 ft level.

Although the investigation is not completed, the test data to date substantiate the following conclusions, the importance of which would undoubtedly be governed by the outside design temperature and the physical properties of the soil in that particular locality:

1. Perimeter losses for concrete slabs laid on the fill should be given added consideration. The concrete slab should not be in direct contact with the concrete footing wall as this provides a path of high heat flow and will materially decrease the effect of insulating the under side of the slab. Approximately 1 in. of insulation should be installed around the perimeter of the slab for reducing heat losses and providing an expansion joint for the concrete.

2. Heat losses to the ground can be materially decreased by insulating the footing walls. The practicability of this application is still questionable. Better results could be obtained by either making the insulation an integral part of the concrete slab or applying insulation between the concrete slab and the fill.

3. A 4 in. concrete slab laid on 9 in. of fill does not provide sufficient resistance to heat flow. Additional insulation would decrease the temperature drop of the heating medium and should provide a more uniform panel surface temperature.

4. The use of a vapor membrane under the fill material does not appear to have any effect upon the moisture movement in the ground under the slab.

5. The test results indicate that the moisture content of the soil under the concrete slab does not change materially from season to season.

Acknowledgment

This research project was made possible by grants from the Graduate School of the University of Minnesota and from the Minneapolis-Honeywell Regulator Co., together with the cooperation of the National Builders, Inc.

JOURNAL SECTION

WILBUR WATSON ASSOCS. MARK 40th YEAR

Wilbur Watson Associates, Cleveland, Ohio, one of the country's leading industrial design firms, has issued a brochure marking the 40th anniversary of the founding of the organization. The firm, which was organized by Wilbur Jay Watson, has been active in the designing of many important buildings, which include marine structures, school and college buildings, and particularly office and commercial buildings.

The present partnership was formed in 1945 by A. G. Hall, architect, T. E. Terry, engineer, M. O. Backlond, engineer, and L. H. Pogalies, engineer. Mr. Pogalies, a member of the ASHVE since 1931, joined the firm in 1916 when it was known as Wilbur J. Watson and Co. Messrs. Hall, Terry and Backlond have also been connected with the organization for a number of years.

KENNARD APPOINTS MICHIGAN REPRESENTATIVE

David S. Falk has been appointed Michigan representative for the Kennard Corp., St. Louis, Mo. Mr. Falk has been associated with the heating and air conditioning industry in the Detroit area for the past eleven years.

Prior to becoming a manufacturer's representative Mr. Falk had been employed as a sales engineer in the Detroit office of The Trane Co., and had served for nearly four years in the armed forces as an engineering officer engaged in sanitary engineering and industrial dust control work. He received his bachelor's degree in mechanical engineering from the University of Michigan in 1936.

Mr. Falk joined the Society in 1943 and is a member of the *ASRE, National Society of Professional Engineers, American Public Health Association*, and the *Engineering Society of Detroit*.

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HEAT TRANSFER & FLUID MECHANICS INSTITUTE

An Institute on Heat Transfer and Fluid Mechanics has been scheduled for June 21, 22, 23, to be held for one day each on the campuses of the University of California, Los Angeles, University of Southern California, and the California Institute of Technology, respectively.

The Institute will present papers on the basic nature of heat transmission and fluid flow, in a program of high scientific level truly representative of the present state of engineering science.

In view of the nature and aims of the Institute, and the importance of this occasion, the Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS has authorized participation by its Southern California and Golden Gate Chapters. The Golden Gate Chapter has appointed as its representatives Edward W. Simons and Oliver W. Johnson; alternates, Frank L. Nemec and Keith O. Alexander, of San Francisco.

Heat transfer, at sub- and supersonic speeds, boiling of liquids, heat transfer in porous metals, dynamics of cavitation, fluid flow at low pressures, and stability of the boundary layer with and without gas injection are among the vital subjects of the day to be considered.

The sessions have been scheduled as follows: June 21—University of California, Los Angeles; June 22—University of Southern California; June 23—California Institute of Technology.

General Chairman is Prof. Robert T. Knapp, director, Hydro-dynamics Laboratory, California Institute of Technology. Prof. L. M. K. Boelter, dean, College of Engineering, University of California, Los Angeles, is Chairman of the Papers Committee. J. C. Dillon, University of California, Los Angeles is Chairman of the Program Committee.

The Institute is sponsored by the California sections of the following organizations: *American Institute of Chemical Engineers, American Society of Civil Engineers,* AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, *American Society of Mechanical Engineers,* the *Institute of the Aeronautical Sciences,* the Fluid Mechanics Division of the *American Physical Society,* the Jet Propulsion Laboratory of the California Institute of Technology, Project *SQUID,* a cooperative research project of five eastern universities and California Institute of Technology, Stanford University, University of California, University of Santa Clara, University of Southern California.

On the third day, the Institute will hold a joint meeting with the Fluid Mechanics Division of the *American Physical Society.* Other meetings of that Society will be held on June 24, 25 and 26. Another interesting event will be a Symposium on Heat Transfer Problems in Jet Propulsion which will be held on Thursday, June 24, and which will be sponsored by the Jet Propulsion Laboratory of the California Institute of Technology and Project *SQUID.*

NEW RADIANT HEATING BOOK

Radiant Heating, by R. W. Shoemaker. This book contains numerous illustrations of methods of constructing and installing coils for heated panels in different types of buildings.

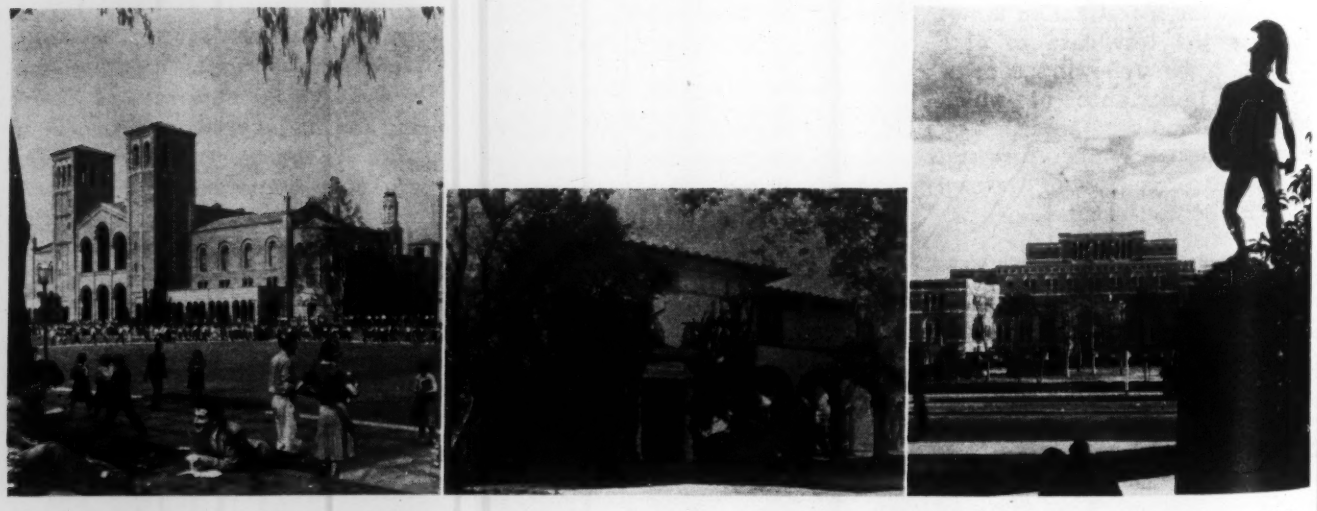
One chapter is devoted to the description of boilers and heat generators, and the factors affecting their heat output and rating. Illustrations and applications of available controls are given.

A general description is included with reference to the various panel heating system design methods which are now in use or advocated by designers and manufacturers.

Methods of fabricating coils manufactured from various pipe materials are described and illustrated.

The final chapter reviews in detail the theory and assumptions upon which computations for panel heating systems are based, and presents fundamental equations from various authorities for the determination of heat transfer values and constants to be used in the equations.

The book is published by McGraw-Hill Book Co., New York. The price is $4.00 a copy.



Left to right—**Royce Hall at UCLA, Ricketts House at CIT, and Edward L. Doheny, Jr., Memorial Library at USC**

JOURNAL SECTION

Periodic Heat Transfer at the Inner Surface of a Homogeneous Wall

By Harold A. Johnson*, Berkeley, Calif.

SUMMARY — The data for the temperature amplitude decrement and the phase lag for periodic heat transfer through a homogeneous wall are extended to include the wall surface heat transfer coefficients as variables. The results of the analytical solution of this problem are presented in a dimensionless closed form and an example illustrates the application.

Introduction

ANALYTICAL methods of periodic heat transfer analysis to predict the summer cooling load for homogeneous single material building walls have been presented in several previous papers [1-7]. To facilitate the general application of these mathematical solutions the results are usually presented in graphical or tabular form including a range of values for the thickness, thermal conductivity, specific heat, and density of the wall material. The results, referred to here as analytical data and which are the inner wall surface temperature amplitude decrement and time or phase lag values, have been limited to particular values of the building wall heat transfer coefficients (film coefficients); Mackey and Wright[4, 5] using fixed values of 4.00 and 1.65 Btu per (sq ft) (hr) (F deg) at the outer and inner wall surfaces respectively. The purpose then is to extend these analytical data and to present the results in graphical form so that the heat transfer (film) coefficients at both wall surfaces, as well as the thermal properties of the wall material, become generalized parameters.

The equations and a computation form for evaluation of the data were developed from an unpublished mathematical derivation by Austin Bryant[8]. The derivation given by Alford, Ryan, and Urban[3], however, will suffice as the closed form of solution obtained is the same, differing only in the use of dimensionless moduli containing the problem parameters.

The letter symbols used in this paper are as follows:

a = thermal diffusivity of the wall material, k/cw, square feet per hour.
c = specific heat of the wall material, Btu per (pound) (Fahrenheit degree).
f = functional quantity defined by equation 7, dimensionless.
g = functional quantity defined by equation 8, dimensionless.
h = air film heat transfer coefficient, Btu per (square foot) (hour) (Fahrenheit degree).
k = thermal conductivity of the wall material, Btu per (square foot) (hour) (Fahrenheit degree per foot).
m = temperature harmonic phase lag angle, (see equation 6) degrees.
q = heat transfer rate per unit of area, Btu per (square foot) (hour).
t = temperature, Fahrenheit.
w = specific weight of the wall material, pounds per cubic foot.
x = distance through the wall in the direction of heat flow, feet.
B_{on} = plate or wall modulus, dimensionless, $= L\sqrt{\pi n/a\Theta_o}$.
D_{on} = air film modulus at outer surface $x = 0$, dimensionless, $= B_{on}\, k/Lh_o$.
D_{Ln} = air film modulus at inner surface $x = L$, dimensionless, $= B_{on}\, k/Lh_L$.
L = plate or wall thickness, feet.
M = temperature harmonic amplitude decrement, dimensionless, see Equation 5.
U = overall heat transfer coefficient, $= \dfrac{1}{\frac{1}{h_o} + \frac{L}{k} + \frac{1}{h_L}}$ Btu per (square foot) (hour) (Fahrenheit degree per foot).
β = air temperature harmonic phase angle, degrees.
Θ = time measured through 24 hours from noon zero, hours.
Θ_o = period of the fundamental or first harmonic, 24 hours.
ϕ = designates a functional relation.
ω = harmonic frequency, cycles per hour.

Subscripts when used with letter symbols indicate the following:

$_a$ designates the outdoor air temperature.
$_c$ designates the indoor air temperature.
$_o$ designates the fundamental or first harmonic period where applied to the time symbol Θ_o and the plate modulus B_{o}.
$_o$ refers to conditions at the outer ($x = 0$) wall surface in all other cases.
$_L$ refers to conditions at the inner ($x = L$) wall surface.
$_m$ designates a mean value.
$_M$ designates a harmonic amplitude value.
$_n$ refers to the number of the Fourier analysis harmonic, n = 1 for the fundamental or first harmonic.
$_s$ refers to the equivalent or sol-air temperature defined by Equation 1*a*.

These quantities are familiar except for the dimensionless B and D moduli defined by the relations as shown. It may be helpful to note that the plate modulus is a modified form of the Fourier modulus, $Fo = a\Theta_o/L^2$, the relation being

$$B_{on} = \sqrt{\pi\, n/Fo}$$

also that the film modulus combines the Biot modulus, $Bi = Lh/k$,

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* Associate Professor of Mechanical Engineering, University of California.

[1] Exponent numerals refer to References.

Presented at the 54th Annual Meeting of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, New York, N. Y., February 1948.

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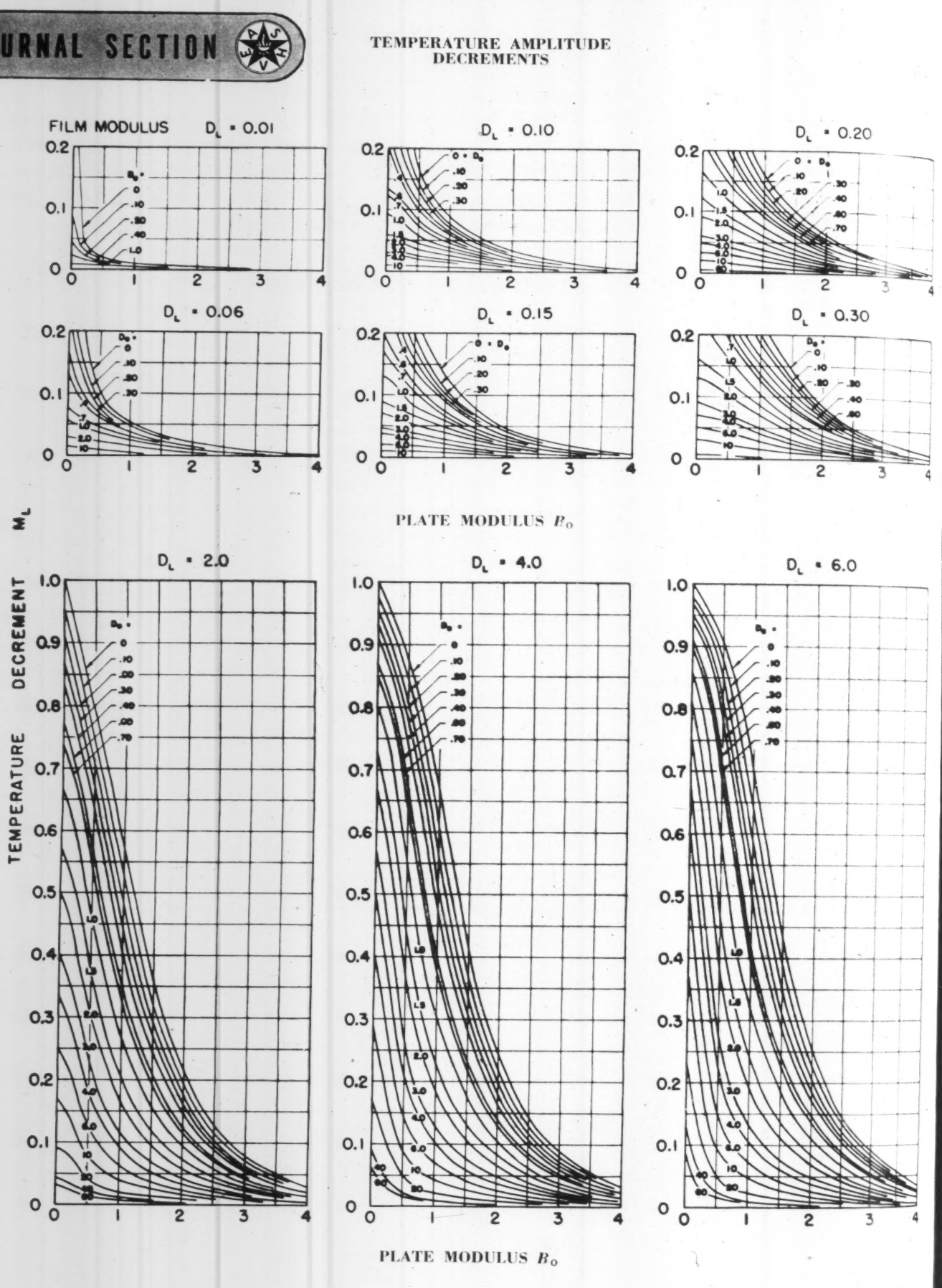
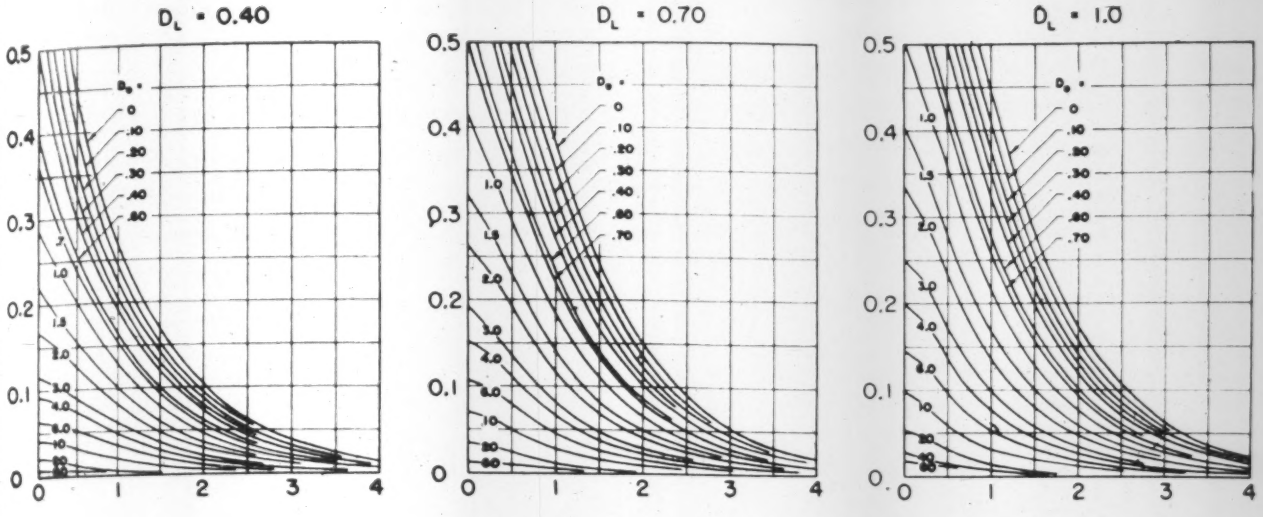
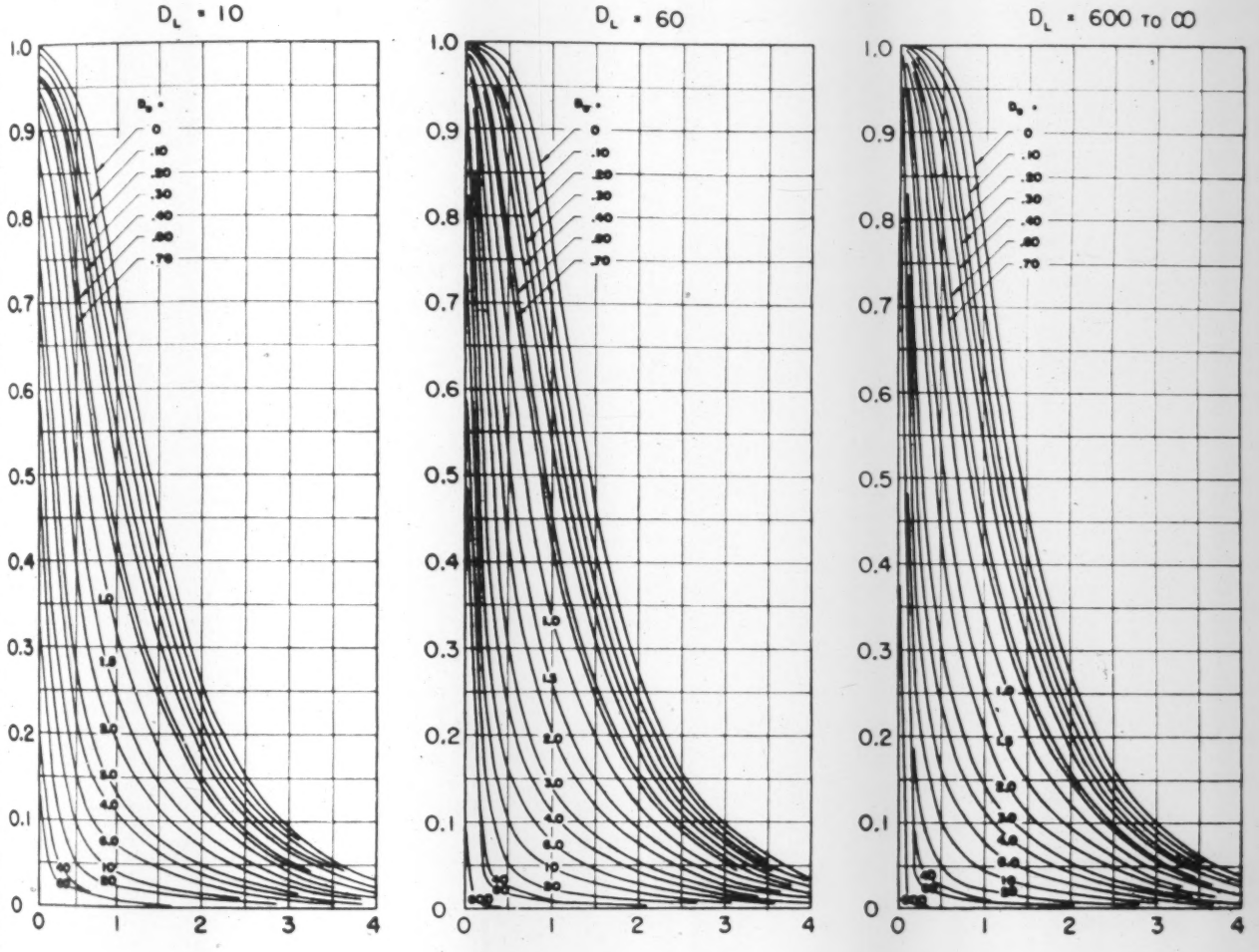


Fig. 1—Temperature amplitude decrements for values of B_o





of B_o from 0 to 4 (for values of B_o to 1.0 see Fig. 2)

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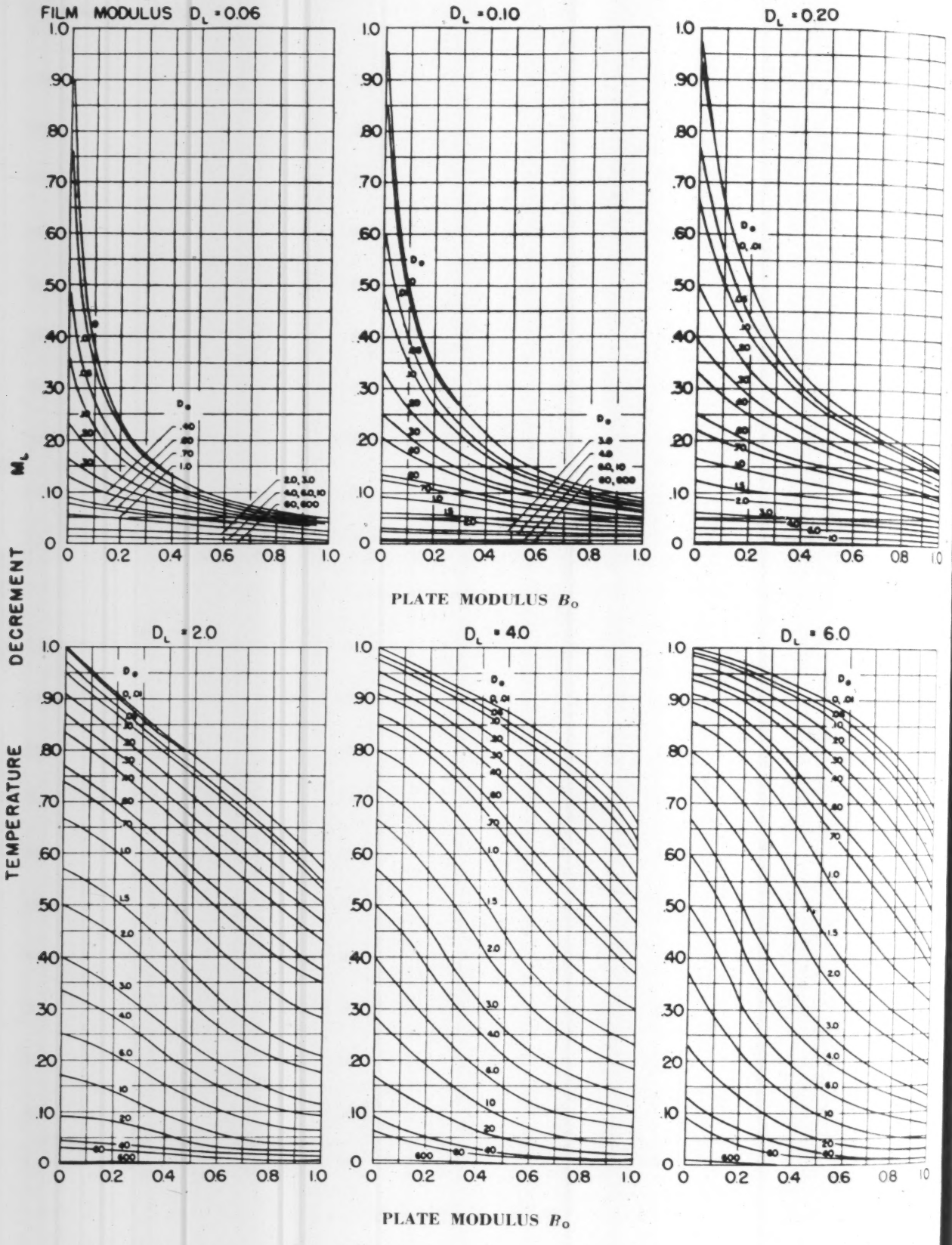
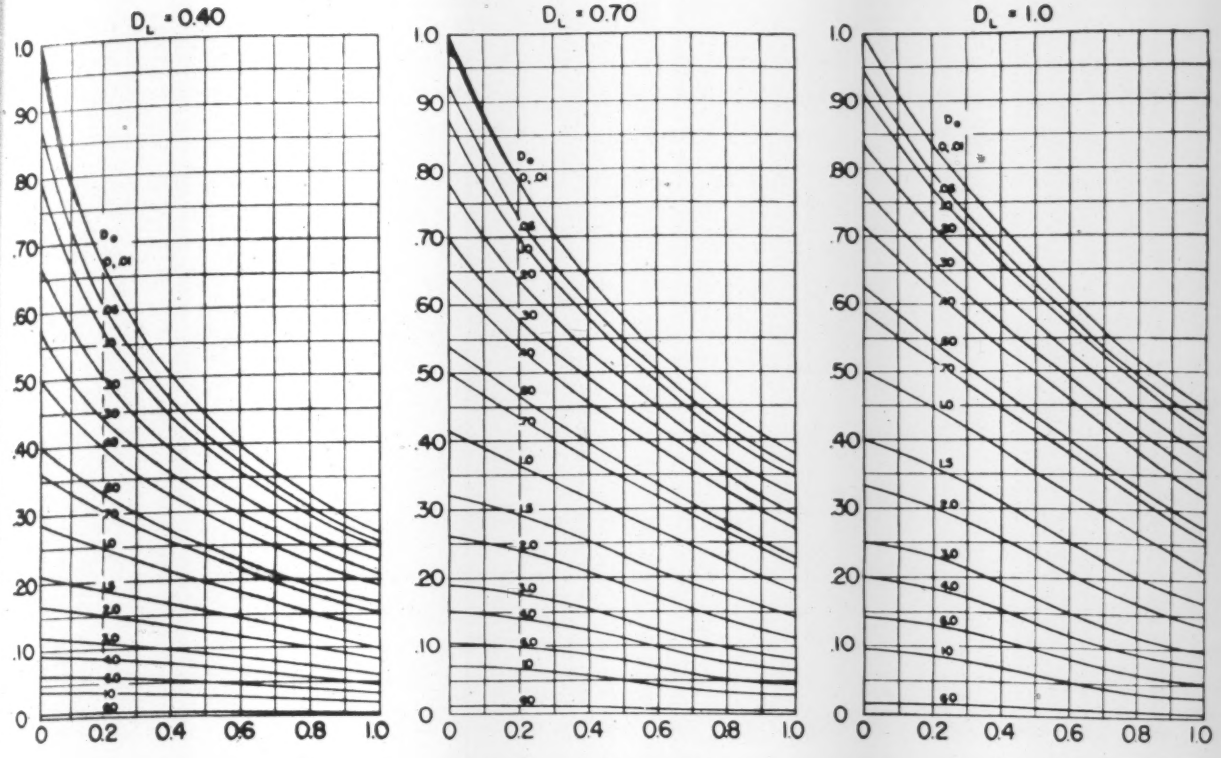
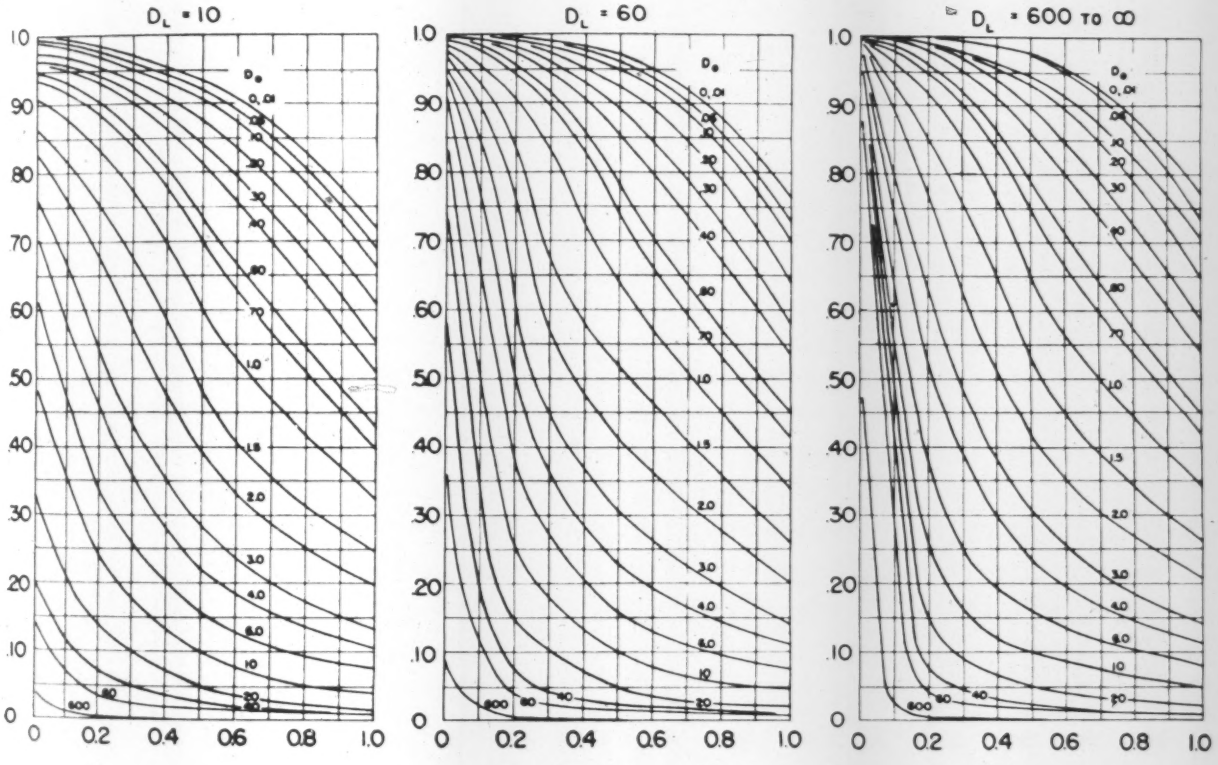
TEMPERATURE AMPLITUDE DECREMENTS



Note: Supplements plot of M_L for values of B_o from 0 to 1.0

Fig. 2—Temperature amplitude decre





ments for values of B_o from 0 to 1.0

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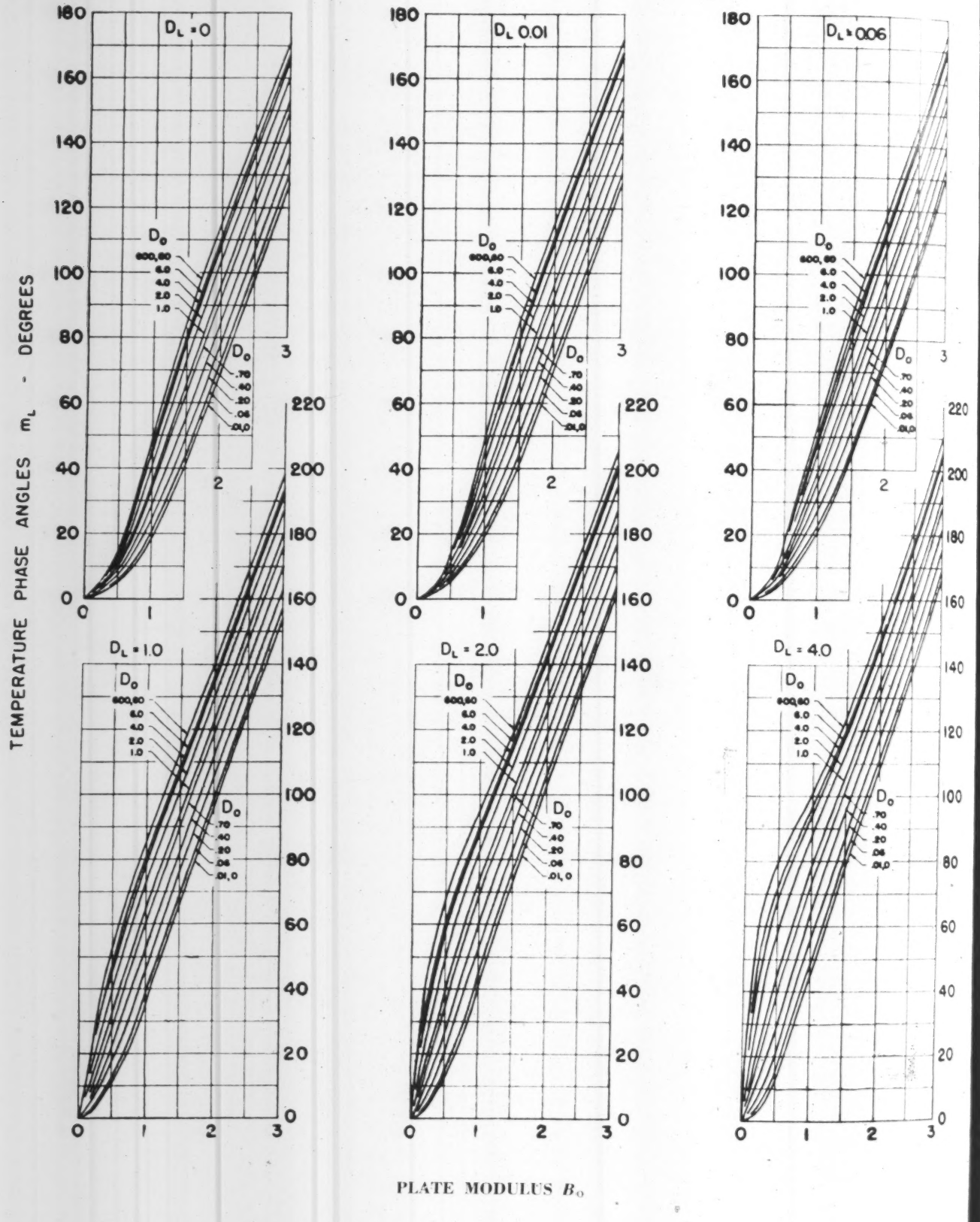
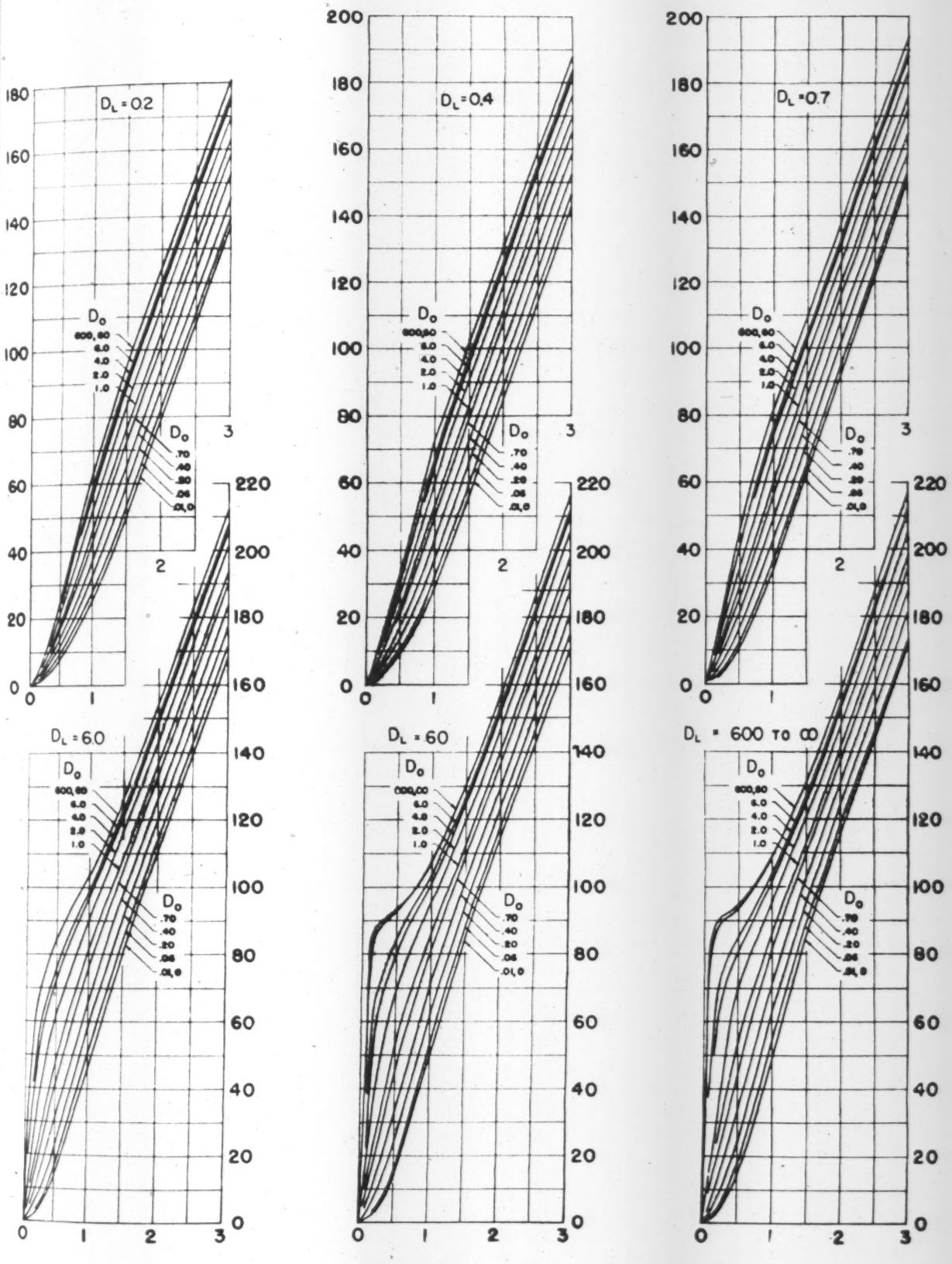


Note: Within the accuracy of the graph scale these angles increase linearly at 57.3 deg (1 radian) for each unit value of plate modulus B_o greater than 3

Fig. 3—Tempera



ture phase angles

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and the Fourier modulus in the form

$$D_{on} = \frac{1}{(Bi)_o}\sqrt{\frac{\pi n}{Fo}} \quad \text{and}$$

$$D_{Ln} = \frac{1}{(Bi)_L}\sqrt{\frac{\pi n}{Fo}}$$

The Analytical Results for Periodic Heat Flow

The analytical solution represents a wall of single homogeneous material construction subjected to the known periodic outdoor air temperature, expressed as a Fourier Series.

$$t_a = t_{am} + \sum_{n=1}^{n} t_{aMn} \cos\,(\omega_n\Theta - \beta_{an}) \qquad \ldots\ldots(1)$$

and a constant indoor temperature.

$$t_c = t_{cm} \qquad \ldots\ldots(2)$$

The differential equation for heat conduction, $dt/d\Theta = ad^2t/dx^2$, is solved for the conditions given by Equations 1 and 2 assuming that the heat transfer coefficients and wall thermal properties are independent of temperature variation. For these conditions the resulting solution for the inner wall surface temperature and heat transfer rate are expressed by

$$t_L = \frac{U}{h_L}\,t_{am} + \left(1 - \frac{U}{h_L}\right)t_{cm} + \sum_{n=1}^{n} t_{aMn} M_{Ln} \cos\,(\omega_n\Theta - \beta_{an} - m_{Ln}) \quad \ldots(3)$$

and

$$q_L = U(t_{am} - t_{cm}) + h_L \sum_{n=1}^{n} t_{aMn} M_{Ln} \cos(\omega_n\Theta - \beta_{an} - m_{Ln}) \quad \ldots\ldots(4)$$

where

$$M_{Ln} = \phi_1\,(B_{on}, D_{on}, D_{Ln}) = \frac{D_{Ln}}{\sqrt{f_n^2 + g_n^2}} = D_{Ln}\,\frac{\sin m_{Ln}}{g_n} \quad \text{see Figs. 1 and 2.} \ldots(5)$$

$$m_{Ln} = \phi_2\,(B_{on}, D_{on}, D_{Ln}) = \tan^{-1} g_n/f_n \quad \text{see Fig. 3.} \ldots\ldots(6)$$

$$f_n = (D_{on} + D_{Ln})\cosh B_{on}\cos B_{on} + \tfrac{1}{2}(\sinh B_{on}\cos B_{on} + \cosh B_{on}\sin B_{on}) + D_{on}D_{Ln}(\sinh B_{on}\cos B_{on} - \cosh B_{on}\sin B_{on}) \ldots\ldots(7)$$

$$g_n = (D_{on} + D_{Ln})\sinh B_{on}\sin B_{on} - \tfrac{1}{2}(\sinh B_{on}\cos B_{on} - \cosh B_{on}\sin B_{on}) + D_{on}D_{Ln}(\sinh B_{on}\cos B_{on} + \cosh B_{on}\sin B_{on}) \ldots\ldots(8)$$

The temperature amplitude decrement, M_{Ln}, and phase lag angle, m_{Ln}, are obtained from Figs. 1, 2 and 3 using linear interpolation for values of D_{Ln}. The data presented in Figs. 1, 2, and 3, for the amplitude decrements and phase lag were evaluated by computation of Equations 5 and 6, using a form like that shown in Table 1.

Table 1—Calculation Form for the Amplitude Decrement, M_{Ln}, and the Phase Lag Angle, m_{Ln}

Operation[a]		$B_1=1.67$	$B_2=2.35$	$B_3=2.89$	$B_4=3.34$	$B_5=3.74$	$B_6=4.0$
	B_n deg	95.68	134.65	165.58	191.37	214.29	230.4
11	sinh B_n	2.562	5.195	8.969	14.09	21.04	29.8
12	cosh B_n	2.750	5.290	9.024	14.13	21.06	29.8
13	sin B_n	0.9951	0.7114	0.2490	−0.1972	−0.5634	−0.8
14	cos B_n	−0.0990	−0.7028	−0.9685	−0.9804	−0.8262	−0.5
15	11 × 14	−0.2536	−3.6510	−8.6865	−13.814	−17.383	−17.8
16	12 × 13	2.7365	3.7633	2.2470	−2.7864	−11.805	−24.2
17	12 × 14	−0.2722	−3.7178	−8.7397	−13.853	−17.400	−17.8
18	11 × 13	2.5494	3.6957	2.2333	−2.7785	−11.854	−24.2
19	15 + 16	2.4829	0.1123	−6.4395	−16.600	−29.248	−41.9
20	15 − 16	−2.9901	−7.4143	−10.934	−11.028	−5.5180	12.3
21	½ × 19	1.2414	0.0562	−3.2198	−8.300	−14.624	−20.9
22	−½ × 20	1.4950	3.7072	5.467	5.514	2.759	−3.1
	D_{on}	0.261	0.368	0.451	0.522	0.584	0.6
	D_{Ln}	0.632	0.892	1.094	1.265	1.417	1.5
23	$D_{on} \times D_{Ln}$	0.1650	0.3282	0.4934	0.6603	0.8275	0.99
24	$D_{on} + D_{Ln}$	0.893	1.260	1.545	1.787	2.001	2.2
25	23 × 19	0.4097	0.0369	−3.1772	−10.961	−23.375	−41.5
26	23 × 20	−0.4934	−2.4334	−5.3948	−7.2818	−4.5661	6.5
27	24 × 17	−0.2431	−4.6844	−13.503	−24.755	−34.817	−48.2
28	24 × 18	2.2766	4.6566	3.4504	−4.9652	−23.720	−51.7
29	21 + 26 + 27	0.5049	7.0616	22.118	40.337	54.007	72.3
30	22 + 25 + 28	4.1813	8.4007	5.7402	−10.412	−44.336	−97.9
31	30/29	8.2848	1.1896	0.2595	0.2581	0.8209	1.8
32	$\tan^{-1}$ 31	83.12	130.05	165.45	194.47	219.38	241.4
33	sin 32	0.9928	0.7654	0.2513	−0.2499	−0.6344	−0.8
34	33/30	0.2374	0.0911	0.0438	0.0240	0.0143	0.0
M_{Ln}	$D_{Ln} \times 34$	0.150	0.081	0.048	0.030	0.020	0.0
M_{Ln}	32	83	130	165	195	219	242

[a] Operation items are numbered from 11 to 34 inclusive.

Table 2—Harmonic Amplitude Decrements and Lag Angles for the Illustrative Example.

Harmonic	n	B_{on}	D_{Ln}	D_{on}	M_{Ln}[a] Chart[b]	M_{Ln} Calc.[c]	m_{Ln} Chart[b]	m_{Ln}
First (fundamental)	1	1.67	0.632	0.261	0.145	0.150	83	8
Second	2	2.35	0.892	0.368	0.085	0.081	129	13
Third	3	2.89	1.094	0.451	0.046	0.048	166	16
Fourth	4	3.34	1.265	0.522	0.029	0.030	193	19
Fifth	5	3.74	1.417	0.584	0.021	0.020	218	21
Sixth	6	4.09	1.550	0.639	0.014	0.014	241	24

[a] Compare the steady flow amplitude decrement. [b] From Figs. 1, 2 and 3.

$M_{Ln} = \dfrac{U}{h_L} = \dfrac{0.406}{1.65} = 0.246$ for all values of n. [c] Calculated from Table 1.

The results for a sample of data computed with this form and also obtained by direct reading and linear interpolation from Figs. 1, 2 and 3 are summarized in Table 2. It is also interesting to note that if the heat capacity of the wall were neglected, *i.e.* using steady flow method of calculation, these results reduce to the simple relations:

$$M_{Ln} = \frac{U}{h_L} = \frac{1}{\dfrac{D_{on}}{D_{Ln}} + \dfrac{B_{on}}{D_{Ln}} + 1} \quad \text{and } m_{Ln} = 0$$

As indicated in Table 2, to obtain an accuracy of better than about five percent these values must be calculated directly from Equations 5 and 6, using the computation form, Table 1. The procedure is illustrated by an example which includes the effect of solar and sky radiation.

Inspection of Equations 1, 2, 3

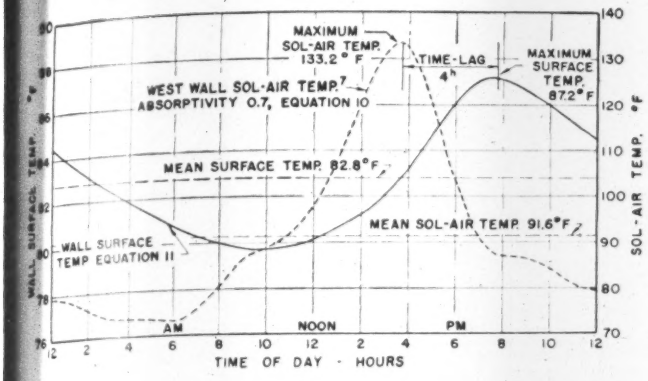

Fig. 4—Sol-air and calculated inner wall surface temperatures

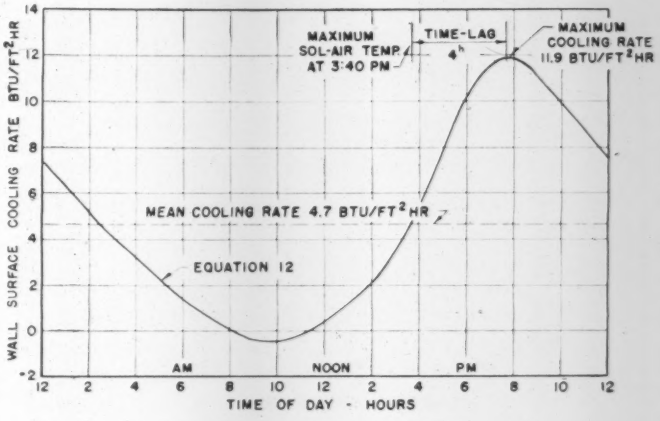

Fig. 5—Calculated inner wall surface heat transfer rate

and 4 will show that all terms containing the mean values of air temperature, t_{am} and t_{em}, express well-known steady or constant heat transfer relations and that the remaining terms are superimposed periodic components. This superposition principle also applies to permit the use of the same form of solution for effects of solar and sky radiant energy exchange. The procedure followed is to calculate a psuedo or equivalent outdoor air temperature which corresponds to a known rate of radiant energy absorption on the outer wall surface. When added to the actual outdoor air temperature throughout the time of day, a second psuedo temperature variation results which replaces the actual temperature represented by Equation 1. Appropriately called the *sol-air temperature* by Mackey and Wright[4], the definition and a brief description are given. The reader, however, is referred to references 3, 4, 7, and 9 for illustrations of methods used in its evaluation.

For radiant energy exchange, Equation 1 is thus replaced by the sol-air temperature

$$t_s = t_a + \frac{1}{h_o}(\chi G_o + \Delta R) = t_{sm} + \sum_{n=1}^{n} t_{sMn} \cos(\omega_n \theta - \beta_{sn}) \quad \ldots\ldots (1a)$$

and Equations 3 and 4 become

$$t_L = \frac{U}{h_L} t_{sm} + \left(1 - \frac{U}{h_L}\right) t_{em} + \sum_{n=1}^{n} t_{sMn} M_{Ln} \cos(\omega_n \theta - \beta_{sn} - m_{Ln}) \quad \ldots\ldots (3a)$$

$$q_L = U(t_{sm} - t_{em}) + h_L \sum_{n=1}^{n} t_{sMn} M_{Ln} \cos(\omega_n \theta - \beta_{sn} - m_{Ln}) \quad \ldots\ldots (4a)$$

Here the radiant energy quantities of Equation 1*a* are:

G_o = combined solar and sky radiation incident upon the outer wall surface from sunrise to sunset, Btu per (square foot) (hour). Data for this are given in the HEATING, VENTILATING, AIR CONDITIONING GUIDE, 1947, p.278.

χ = absorptivity of the outer wall surface for solar radiation.

ΔR = radiant energy exchange between the sky and outer wall surface from sunset to sunrise which is approximated by the relation

$$\Delta R = 0.173 \times 10^{-8} \varepsilon F (T_{es}^4 - T_o^4), \text{ Btu per (sq ft) (hr)} \quad \ldots\ldots (9)$$

where

ε = the outer wall surface low temperature emissivity.

F = the wall to sky shape factor (unity for a horizontal surface and one-half for a vertical surface.)

T_{es} = the effective nocturnal sky absolute temperature, (−60 F for a clear sky.[9])

T_o = outer surface wall absolute temperature, [may be approximated at the mean outdoor air temperature $T_{am} = t_{am}$ Fahrenheit + 460].

It is also understood that the outer wall surface heat transfer (film) coefficient h_o will include the low temperature radiation h_r = 1.3 Btu per (sq ft) (hr) (F deg)[3]. The latter approximates the radiant energy exchange between the wall surface and surroundings other than the sky which are considered to be at the outdoor air temperature, t_a.

From this it is seen that the sol-air temperature correctly accounts for radiant energy effects only if the radiant energy absorbed by the wall can be correctly evaluated and the method given here is at best an approximation.

Illustrative Example

To demonstrate the use of the equations and charts it will be convenient to use the Mackey and Wright example[7] in which the sol-air temperature is given as

$$t_s = t_{sm} + \sum_{n=1}^{n} t_{sMn} \cos(\omega_n \theta - \beta_{sn})$$

$$= 91.6$$
$$+ 23 \cos(15\theta - 51)$$
$$+ 9.1 \cos(30\theta - 92)$$
$$+ 5.9 \cos(45\theta - 166)$$
$$+ 3.6 \cos(60\theta - 217)$$
$$+ 1.0 \cos(75\theta - 292)$$
$$+ 0.93 \cos(90\theta - 68) \quad \ldots\ldots (10)$$

This temperature variation (see Fig. 4) corresponds to conditions

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for an unshaded west wall with a solar absorptivity of 0.7. The wall is of homogeneous red brick construction having the properties:

Thickness, L .....=8 in. = 0.667 ft
Thermal conductivity, k....=5 Btu per (sq ft) (hr) (F deg per in.) = 0.416 Btu per (sq ft) (hr) (F deg per ft).
Volumetric specific heat, cw =20 Btu per (cu ft) (F deg).
Thermal diffusivity, a.....=k/cw = 0.416/20 = 2.08 × 10^{-2} (sq ft) per hr.

The inside air temperature is taken at 80 F and the heat transfer coefficients are:

h_o = 4.0 Btu per (sq ft) (hr) (F deg), h_L = 1.65 Btu per (sq ft) (hr) (F deg).

and

$$U = \frac{1}{\frac{1}{h_o} + \frac{L}{k} + \frac{1}{h_L}} = \frac{1}{\frac{1}{4.0} + \frac{8}{5} + \frac{1}{1.65}} = 0.406 \text{ Btu per (sq ft) (hr) (F deg)}.$$

Substitution into the defining relations for the three moduli reduce to:

$$B_{on} = L\sqrt{\pi n/a\Theta_o} = \sqrt{0.667\,\pi n/0.0208 \times 24} = 1.67\sqrt{n}$$

$$D_{on} = B_{on}\,k/Lh_o = 1.67\sqrt{n} \times 0.416/0.667 \times 4.00 = 0.261\sqrt{n}$$

$$D_{Ln} = B_{on}\,k/Lh_L = 1.67\sqrt{n} \times 0.416/0.667 \times 1.65 = 0.632\sqrt{n}$$

where

n = the number of the Fourier Series harmonic (n = 1 for the fundamental or first harmonic).

For these moduli, the values of the temperature amplitude decrement M_{Ln} and lag angle m_{Ln} as obtained from Figs. 1, 2 and 3 and by calculation are tabulated in Table 2. The computation form illustrating the calculation procedure has been given as Table 1.

Substitution of the calculated results from Table 2 into Equation 3*a* gives the inside surface temperature.

$$t_L = \frac{U}{h_L} t_{sm} + \left(1 - \frac{U}{h_L}\right) t_{cm} + \sum_{n=1}^{n} t_{sMn} M_{Ln} \cos(\omega_n\Theta - \beta_{sn} - m_{Ln})$$

$$= \frac{0.406}{1.65} \times 91.6 + \left(1 - \frac{0.406}{1.65}\right) 80 + \sum_{n=1}^{n} t_{sMn}\, M_{Ln} \cos(\omega_n\Theta - \beta_{sn} - m_{Ln})$$

$$= 82.8 + 3.45\cos(15\Theta - 134) + 0.74\cos(30\Theta - 222) + 0.28\cos(45\Theta - 331) + 0.11\cos(60\Theta - 52) + 0.02\cos(75\Theta - 151) + 0.01\cos(90\Theta - 310) \quad \ldots\ldots\ldots\ldots (11)$$

Similarly, from Equation 4*a*, the inside surface heat transfer rate is

$$q_L = U(t_{sm} - t_{cm}) + h_L \sum_{n=1}^{n} t_{sMn} M_{Ln} \cos(\omega_n\Theta - \beta_{sn} - m_{Ln})$$

$$= 4.71 + 5.69\cos(15\Theta - 134) + 1.22\cos(30\Theta - 222) + 0.46\cos(45\Theta - 331) + 0.18\cos(60\Theta - 52) + 0.03\cos(75\Theta - 151) + 0.02\cos(90\Theta - 310) \quad \ldots\ldots\ldots\ldots (12)$$

The results as expressed by Equations 11 and 12 are plotted in Figs. 4 and 5 from which are obtained the time lag of 4 hours and the maximum cooling rate of 11.9 Btu per (sq ft) (hr). In reference 7 Mackey and Wright discuss this example in detail and show approximations for the time lag and cooling rate which do not require a plot of the Fourier Series.

Acknowledgment

This study in periodic heat flow may be attributed to the constant encouragement given by Dean L. M. K. Boelter, University of California. The data presented in the charts represent a small part of the work done by former engineering students and others at the University of California. Thanks are due to Messrs. J. T. Gier, A. U. Bryant and Mrs. D. J. Voight at the University of California, Berkeley Campus, and to Messrs. W. L. Martin, Myron Tribus, J. H. Hazen and others in the Engineering Projects Research Office at the University of California, Los Angeles Campus.

References

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2. Heat Transfer Notes, by L. M. K. Boelter, V. H. Cherry, H. A. Johnson and R. C. Martinelli. (*University of California Press*, Berkeley and Los Angeles; 1946, p. VI, 26.)

3. Effect of Heat Storage and Variation in Outdoor Temperature and Solar Intensity on Heat Transfer Through Walls, by J. S. Alford, J. E. Ryan, and F. O. Urban. (ASHVE TRANSACTIONS, Vol. 45, 1939, p. 369.)

4. ASHVE RESEARCH REPORT No. 1253—Periodic Heat Flow—Homogeneous Walls or Roofs, by C. O. Mackey and L. T. Wright, Jr. (ASHVE TRANSACTIONS, Vol. 50, 1944, p. 293.)

5. HEATING, VENTILATING, AIR CONDITIONING GUIDE 1947, pp. 272-282.

6. Transient Heat Load in Calculating Air Conditioning Loads, by E. M. Pugh. (*Journal American Society Refrigerating Engineers*, July 1941, pp. 29-33.)

7. Summer Comfort Factors as Influenced by the Thermal Properties of Building Materials, by C. O. Mackey and L. T. Wright, Jr. (ASHVE TRANSACTIONS, Vol. 49, 1943, p. 148.)

8. Operational Solution of Some Problems in Heat Transfer, by A. U. Bryant. (*Master of Science Thesis*, University of California, 1940, 53 numbered leaves.

9. ASHVE RESEARCH REPORT No. 1298—The Sol-Air Thermometer—A New Instrument, by C. O. Mackey and L. T. Wright, Jr. (ASHVE TRANSACTIONS, Vol. 52, 1946.)

DISCUSSION

MR. NULTEY, Gainesville, Fla., suggested that the method of determining periodic heat flow was too complex for application by the engineer. He asked whether any further work had been done on the electrical analogy method described in a paper[1] published several years ago.

C. S LEOPOLD, Philadelphia, Pa., remarked that the engineer needed to solve problems the correct way even if difficult. He mentioned that in a series of experiments with incandescent lighting as a source of heat in an interior zone, equilibrium was found to be of vast practical importance and equilibrium was not reached in an 8-hour day. With proper air supplied to maintain a constant temperature, equilibrium would not be reached in five 8-hour days. Periodic heat flow is important and the discrepancy between the calculated steady state and the actual (measured by hydraulic analogy with which he is experimenting) effect of the difference of temperature required is of practical significance.

CHAIRMAN TUVE asked the author whether practical construction would fall within a plate modulus range of 4. He also emphasized the importance of wall temperature upon control problems since controls are affected by the wall temperatures.

P. R. ACHENBACH asked whether the period and amplitude of the sun's radiant energy curve had to be determined for each latitude. He also asked whether the walls considered in the paper were south walls.

PROFESSOR JOHNSON agreed with Mr. Nultey that the analytical method was too complex for engineering use, but pointed out that its purpose was to present an analysis which might be used as a basis in obtaining satisfactory experimental data, and also for comparing experimental work. The author did not feel that it was necessary at the present time to attempt to reduce the calculation procedures to simple tables for practical use.

Replying to Professor Tuve, the author stated that the range of the plate modulus 0 to 4 was sufficient to include all possible constructions.

Referring to Mr. Achenbach's question, Professor Johnson stated that the radiant energy information used was obtained from the Weather Bureau which used pyrheliometers in measuring the solar energy. Two means of measuring solar radiation with greater precision are now being investigated by the University of California, but for the present it is necessary to use the data from the Weather Bureau which include not only radiation from the sun, but also sky radiation and diffused energy from the sky. For periodic heat flow analysis applying to several walls of a building, it would be necessary to measure radiation independently from all directions.

[1] Periodic Heat Flow in Building Walls Determined by Electrical Analogy Method, by Victor Paschkis. (ASHVE TRANSACTIONS, Vol. 48, 1942, p. 75.)

W. N. LAMBECK, 50, DIES

Walter N. Lambeck, service manager and heating engineer, Wisconsin Ice & Coal Co., Milwaukee, Wis., died on February 3, 1948, at the age of 50.

Born in Milwaukee on June 13, 1897, Mr. Lambeck received his engineering training at the University of Wisconsin, Marquette University and the Milwaukee School of Engineering. One of his first positions was that of partner in the Weingart-Lambeck Co., specializing in automotive starting, lighting and ignition. In 1926, he became manager of the radio department for the Kesselman-O'Driscoll Co. Two years later he joined the staff of H. M. Steussy, Inc., as manager of sales and service for the radio department. His next position was with the Fidelity Investment Association, where he remained for three years. He joined the Wisconsin Ice and Coal Co. in 1945, where he was active in supervising surveys and installations of heating, refrigerating and air conditioning equipment.

Mr. Lambeck became a member of the Society in 1945 and was an active member of the Wisconsin Chapter.

He leaves a widow, to whom the Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sincere sympathy.

DEATH OF C. A. BENNETT

C. A. Bennett, assistant mechanical inspector, Department of Justice, Bureau of Prisons, died recently. Mr. Bennett had been a member of the Society since 1936.

Born on May 6, 1881, Mr. Bennett was a native of York, Pa. In 1905, after completing his preparatory education in York public schools, he received his BS in electrical engineering from Pennsylvania State College. After graduating, he joined the staff of the General Electric Co., and in 1916 became associated with the Davison Chemical Co., as a mechanical and electrical engineer. After seven years with this company he opened his own consulting engineering office. In 1927 he joined the U. S. War Department quartermaster general's office as a mechanical engineer. Two years later he became chief of the mechanical division of the Municipal Airport District of Columbia. Prior to his last position with the U. S. Bureau of Prisons he served for three years as an electrical engineer with the Navy Department, Bureau of Yards and Docks.

The Officers and Council of the ASHVE, extend their sympathy to his family.

ENGLISH LIFE MEMBER DIES

Henry H. Jennins, Leeds, Yorkshire, England, died on January 1, 1948, according to word received recently. Mr. Jennins, a Life Member of the ASHVE, would have been 86 on January 29. He had retired from his position as managing director of Edwin Oldroyd and Co., Ltd., in 1930.

Mr. Jennins served his apprenticeship in heating and ventilating with the Edwin Oldroyd Co., Ltd., from 1875 until 1879. For the next three years he was associated with John Fowler & Co., mechanical engineers, where he received his drafting experience. In 1882 he returned to the Oldroyd Co., as a foreman, later becoming works manager. His last position was as managing director with full control of one of the most successful heating and ventilating businesses in England.

The Officers and Council of the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS extend their sympathy to his daughter, Mrs. G. Smith, and other members of his family, for their sad loss.

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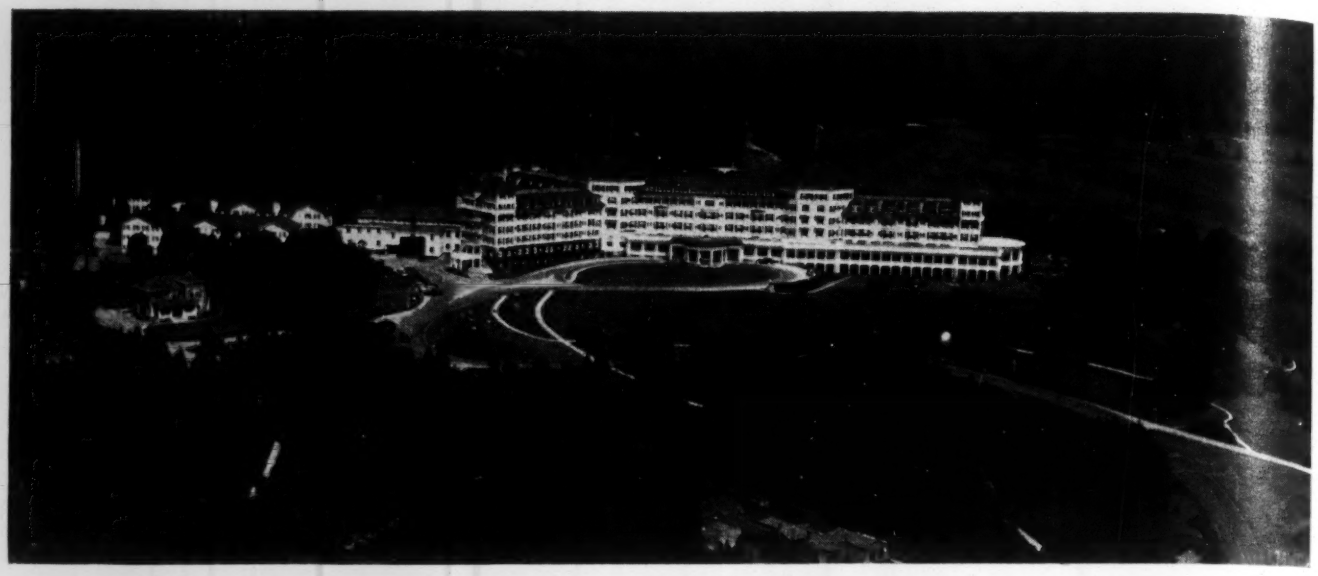


The Mount Washington Hotel is the meeting headquarters

June Meeting in the White Mountains

THE SEMI-ANNUAL Meeting 1948 will be held in nationally known Bretton Woods, N. H., and headquarters for the Meeting will be at the Mount Washington Hotel, June 20-23.

The Massachusetts Chapter will act as hosts for the Meeting and the Committee on Arrangements will be:

C. M. F. Peterson, *General Chairman*
James Holt, *Vice Chairman*
Banquet—Hugo Von Rehberg
Entertainment—C. W. Larson
Finance—J. W. Brinton
Ladies—Adolph Ehrenzeller
Publicity—D. W. Blair
Reception—E. A. Dusossoit
Sports—A. C. Bartlett
Transportation—W. H. Shipp

A. E. Stacey, Jr., chairman of the Program and Papers Committee, announces a technical program which features a session on health and comfort, one on heat transfer, and another which includes papers on temperature distribution with floor panels, fan selection, and weather conditions.

The general sessions will be held in the ballroom commencing on Monday, June 21. The Council and numerous committees will hold meetings on the 20th, when registration will start. During the Meeting, the Chapter Delegates will assemble to discuss problems of mutual interest, and the Nominating Committee will formally meet to select candidates for office.

The several committees in charge of entertainment and sports are planning interesting events for all the members who attend, including a ride on the world-famous cog railway, mountain hiking, a fishing trip, and a golf meet for the Research and Eichberg Memorial Cups.

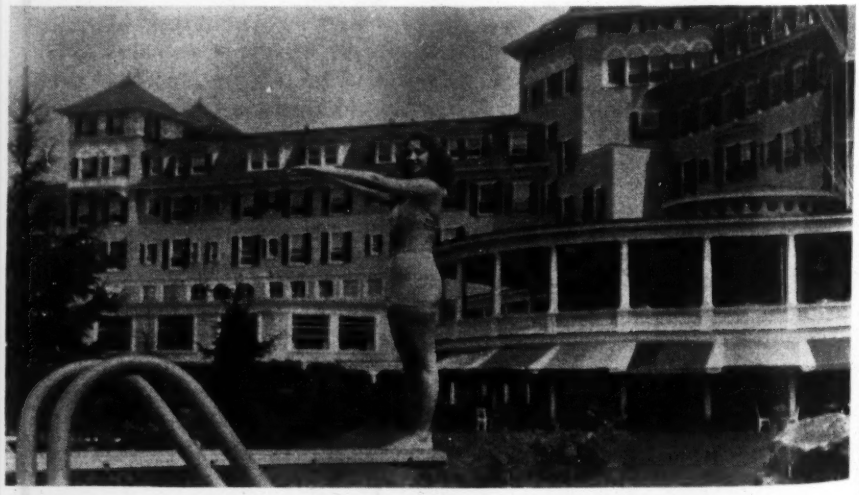
Train service from eastern and western points may be via New York or Boston as desired and early train reservations are advisable. Those who motor will find good roads to the White Mountains.

The location of the Mount Washington Hotel is 1600 ft above sea level and in close proximity is the great Mount Washington with its snow-capped summit.

Golf, tennis, swimming in the outdoor or indoor pools, and fine bridle paths for riding are among the attractions.

The special hotel rates, American plan, including meals, provide double rooms with bath $13.00 per person, per day; single rooms with bath $15.00 per person, per day; rooms with hot and cold running water $12.00 per person, per day.

Further details about the meeting Program will come to Society members in the mail with hotel reservation forms and information about Bretton Woods.



Swimming, golf, tennis, and fine bridle paths for riding are among the attractions at Bretton Woods

C. M. F. Peterson

PROGRAM

Semi-Annual Meeting 1948

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

James Holt

Mount Washington Hotel, Bretton Woods, N. H.

Sunday, June 20

1:00 p.m. Registration
2:30 p.m. Council Meeting

Monday, June 21

9:00 a.m. Registration
10:00 a.m. Technical Session
Greetings by General Chairman, Committee on Arrangements
Response by Pres. G. L. Tuve
Report of Committee on Research—L. N. Hunter, Chairman
Presentation of Technical Papers
10:30 a.m. Croquet and Quoits Tournament for Ladies
12:30 p.m. Get-Together Luncheon
2:00 p.m. Cograil Trip to Mount Washington
Informal Golf and Tennis
6:30 p.m. Dinner
8:00 p.m. Nominating Committee
8:30 p.m. Movies—Barn Dance

Tuesday, June 22

9:30 a.m. Technical Session
Presentation of Technical Papers
10:00 a.m. Ladies Hike to the Falls and Picnic Lunch
2:00 p.m. Golf Tournament for Research and Eichberg Memorial Cups
Fishing
Sightseeing Automobile Trip
6:30 p.m. Dinner
8:30 p.m. Square Dance and Games

Wednesday, June 23

9:30 a.m. Technical Session
Presentation of Technical Papers
10:00 a.m. Ladies Bridge
12:30 p.m. Luncheon
2:00 p.m. Baseball Game, Swimming, Tennis
7:00 p.m. Banquet
Toastmaster—Prof. James Holt
Awarding of Prizes
Address by Laurence F. Whittemore

Method of Choosing Location of, Financing and Conducting Meetings of the Society

Resolved: That inasmuch as the Annual and Semi-Annual Meetings of the Society come under the jurisdiction of the Council, the following rules governing the handling of such meetings be adopted by the Council and published in the JOURNAL of the Society at least twice during every year, preferably just prior to each meeting.

1—The Council will select the city in which the Annual or Semi-Annual Meeting is to be held, giving due consideration to the invitations received from Chapters or members as well as to the advisability of so distributing those meetings as to make them of the greatest advantage to the general membership, and to reduce as far as possible the expense of members attending.

2—That an appropriation be made to cover the entertainment or local expenses, incurred in connection with the meeting, not exceeding $500.00, the regular meeting expense to be taken care of by the General Fund of the Society in the regular way.

3—That no registration fee or compulsory obligations of any nature be imposed on members or guests.

4—That the purchase of tickets for banquets or for any other form of entertainment that may be provided be entirely voluntary.

5—That the grouping of features and the sale of tickets for group features be discouraged.

6—That the raising of funds from manufacturers of heating apparatus be discouraged.

7—That the display of samples, or of literature, advertising the product of any manufacturer in any way, shape or form, be not permitted at the booths, registration desk, or in or about the meetings.

8—That the distribution of trade papers be entirely at the discretion of the committee in charge.

9—That the local Chapter or local members be empowered to form a General Committee with such sub-committees as may be required to handle the details of transportation, hotel accommodations, entertainment, finance, etc., and that this General Committee be requested to confer frequently with the Council, through the Secretary of the Society, and to make frequent reports on progress in connection with the various matters being handled by them.

10—That the arrangements of elaborate and costly entertainment features be discouraged.

Adopted at Council Meeting, January 29, 1926.

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Summary of Local Chapter Meetings*

ATLANTA—March 5, 1948. Subject: Challenge of the ASHVE Research Program. Speaker: Cyril Tasker, director of research, ASHVE Research Laboratory, Cleveland, Ohio. Mr. Tasker illustrated his informative and interesting talk with slides. Other Features: E. K. Jamison, treasurer, reported that a good response was received to an appeal for prompt payment of 1948 chapter dues and also reported on the favorable financial standing of the chapter. Attendance 62. Attendance ratio 0.60.

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CENTRAL NEW YORK—January 27, 1948. Subject: Technology Tomorrow. Speaker: Dr. Baldwin M. Woods, president of ASHVE, and director, university extension, University of California, Berkeley, Calif. Dr. Woods' address proved of great interest to the members and guests. In his talk he listed inventions in the fields of communication, transportation and motion pictures as the outstanding developments of recent years. He stated that any future developments must have characteristics similar to these and must be capable of utilizing power sources which are universally obtainable. The need for improvement in the field of home appliances, which at best are only 60 percent efficient at present, was also pointed out by Dr. Woods. Attendance 62.

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CENTRAL OHIO—February 23, 1948. Subject: Practical Side of Panel Heating. Speaker: Samuel R. Lewis consulting engineer, Chicago, Ill., and life member and past president of ASHVE. Mr. Lewis pointed out many of the difficulties and problems which have been encountered in the panel heating field. His stimulating talk evoked a great deal of comment and a lively discussion period was held. Attendance 60.

CENTRAL OHIO—January 19, 1948. Subject: Inspection of Owens-Corning Fiberglas Plant. Before the inspection trip began, Mr. Atkinson, Owens-Corning Fiberglas Corp., gave a brief synopsis of what would be seen. The trip was extremely interesting and enjoyed. Members and their guests were able to view the steps in the manufacture of glass wool insulation and Fiberglas filters from the raw material to the finished product. A discussion on the scope of the company's laboratory was also given. Other Features: H. R. Allonier briefly discussed phases of the Columbus Smoke Abatement Program. A guest at the meeting was A. V. Hutchinson, secretary of the Society. Attendance 41. Attendance ratio 0.28.

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DELTA—February 17, 1948. Subject: Engineered Air Distribution. Speaker: V. M. Lathers, sales engineer, Barber-Colman Co., Rockford, Ill. Mr. Lathers' talk was followed by questions from the floor. Other Features: Frank Graham reported on the present local building code and after a brief discussion, a motion was carried that a committee be appointed to investigate revisions of the code. Attendance 30.

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ILLINOIS—March 8, 1948. Subject: The Heat Pump. Speaker: M. S. Oldacre, chairman, Utilities Research Commission. Mr. Oldacre, using slides, compared the heat pump with the home refrigerator, and explained the similarities in the operation of the refrigeration unit with the actual operation of the heat pump as used for heating buildings. Other points which Mr. Oldacre brought up in his discussion were, while heating of buildings in winter and cooling in summer can be handled by the heat pump, this method is somewhat expensive at present. The primary sources of heat utilized by the heat pump were given as the atmosphere, well systems, buried coil systems, and river, lake or city water. Mr. Oldacre used slides to show test panels and equipment used in a heat pump system and slides were also shown of various types of buildings now being heated by this method. Other Features: Pres. W. A. Kuechenberg announced the coming Chicago Technical Conference and stated that a session of the meeting would be sponsored by the Illinois Chapter. The subject at this session will be the Heat Pump with Messrs. Oldacre and E. E. Gygax as speakers. Attendance 153. Attendance ratio 0.29.

•

INDIANA—January 23, 1948. Subject: Energy Sources of Tomorrow. Speaker: R. A. Sherman, a member of the Society's Council, and assistant director, Battelle Memorial Institute, Columbus, Ohio. Mr. Sherman's talk proved very informative to members. Other Features: I. W. Cotton and T. R. Davis were appointed delegates to the 54th Annual Meeting. Attendance 35.

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IOWA—March 3, 1948. Subject: Process Air Conditioning. Speaker: Lester T. Avery, president, Avery Engineering Co., Cleveland, Ohio. Mr. Avery stressed the fact that low humidity control, cleanliness, air sterilization, and air distribution are essential in process air conditioning. His talk was accompanied by slides giving views of actual installations. Other Features: A report was given by the committee on the Air Conditioning Conference scheduled at Iowa State College March 22 and 23. C. A. Wheeler, president, appointed a nominating committee to select

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

candidates for 1948 officers. A motion was carried that past president pins be purchased for all living past presidents of the Iowa chapter. Attendance 45.

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KANSAS CITY—February 9, 1948. Subject: Discovery and Development of the *Fluid Drive*. Speakers: Carl Clegg, district manager, American Blower Corp., Kansas City, Mo., and John Rosebrough, fluid drive department, American Blower Corp., Detroit, Mich. Mr. Clegg traced the discovery and early development of the fluid drive from its discovery in Hamburg, Germany, by Dr. Föttinjer in about 1910, to its subsequent development by Dr. Bauer, who was working on the drive when it was used chiefly in connection with the power plants of German warships, and concluded with the work of Dr. Sinclair who, in 1925, began working on the fluid drive in England. It was at this time that the American Blower engineers also began working on the fluid drive. Mr. Rosebrough presented an excellent talk, illustrated with slides and a working model, covering the technical side of the drive. Other Features: The treasurer gave his report and it was announced that W. A. Reichow had been elected secretary-treasurer of the Technical Societies Council, while E. E. Ralston was announced as the new chapter representative on this council replacing D. M. Allen. Mr. Allen, recently elected to the Society's Council, spoke on his experiences at his first Council Meeting held during the recent Annual Meeting in New York. Attendance 42.

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MANITOBA—February 20, 1948. Subject: The 54th Annual Meeting of ASHVE, New York, N. Y. Speaker: J. R. Stephenson, J. R. Stephenson & Co., Winnipeg, Manitoba, Canada. He commented particularly on the hospitable manner with which the Canadians were treated and stated that the Canadian Room was a particular object of admiration. Other Features: An open discussion was held on securing speakers for monthly meetings. An announcement was made that Pres. G. L. Tuve could attend the April 15 meeting of the Manitoba Chapter and plans were made for extending an invitation to President Tuve and arranging for his trip and the special meeting. Attendance 10.

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MASSACHUSETTS—March 16, 1948. Subject: Threadless Malleable Fittings for Brazed Joints. Speaker: H. A. Sosnin, Stanley G. Flagg & Co., Inc. Mr. Sosnin not only described these comparatively new fittings but demonstrated their use by making various joints in steel, copper and brass pipes. A discussion period followed. Attendance 54.

MASSACHUSETTS—February 17, 1948. Subject: Fire Protection and Prevention for Duct Systems. Speaker: R. E. Corson, construction laboratory, Associated Factory Mutual Fire Insurance Cos. The purpose of the meeting and discussion was to present information regarding fire protection and prevention for duct systems and air conditioning equipment as loss of life and damage to property by fire may be caused by neglect or ignorance on the part of the design engineer. Other Features: Nominations for board of governors for 1948-1949 were placed before members. Attendance 64. Attendance ratio 0.76.

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MEMPHIS—February 16, 1948. Subject: Operation and Program of the William R. Moore School of Technology. Speaker: J. Lister Skinner, director, William R. Moore School of Technology. Mr. Skinner's talk on the operation and program of the school proved of interest to members. Other Features: E. E. Scott, Chapter delegate to the 54th Annual Meeting, reported on recommendations made at the meeting. Mr. Scott also announced that the Society is making available past presidents' pins, which can be secured from the secretary of the society. Carl Fischer, treasurer, reported on chapter finances. Attendance 23. Attendance ratio 0.52.

MEMPHIS—January 26, 1948. Subject: Movie Travelogue on Louisiana. Speaker: Virgil Cox, Standard Oil Co. Members greatly enjoyed Mr. Cox's showing of the travel film on Louisiana. Other Features: Discussion was held on expense accounts for Chapter Delegates to Annual Meetings. Attendance 19. Attendance ratio 0.43.

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MICHIGAN—March 15, 1948. Subject: Industrial Ventilating Standards. Speakers: Gordon C. Harrold, Ph.D., industrial hygiene consultant, and W. J. Rettenmier, Spitzley-Rettenmier Co. Dr. Harrold, the first speaker, spoke on the subject, industrial ventilation standards as related to health and safety. Using the Wisconsin Industrial Ventilation Code as an example of one of the better, as well as one of the simpler and more workable of our present codes, he traced the limitations of all present-day codes. Mr. Rettenmier, one of the charter members of the *Industrial Ventilation Society*, told of the organization of this group in Detroit and explained its aims and activities, especially in regard to the working out of a code of rules for good standard practice in industrial ventilation design. Both speakers appealed to the chapter to assist in producing a more suitable and workable state code to replace the present outdated Michigan Industrial Ventilation Code. A rising vote of thanks was accorded Dr. Harrold and Mr. Rettenmier for their interesting and informative talks. Other Features: A report on future meeting programs was given and the chairman of the membership committee submitted his report. Attendance 80.

MICHIGAN—February 16, 1948. Subject: Design of the Heat Pump. Speaker: F. R. Ellenberger, air conditioning department, General Electric Co., Bloomfield, N. J. Mr. Ellenberger covered the fundamentals of the heat pump, the problems of design, and the advantages of its use where a low-grade heat source is available. He concluded with predictions as to the possible future of this type of system. This stimulating and timely presentation was illustrated with slides. Other

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Features: Because of delays incurred in handling the large attendance, all chapter business was postponed to the next meeting. Attendance 175.

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MINNESOTA—March 1, 1948. Subject: Kathabar Applications for Residential and Industrial Installations. Speaker: F. M. Johnson, sales manager, Surface Combustion Corp., Toledo, Ohio. Mr. Johnson used a number of effective slides to illustrate his talk. The many questions asked by members following Mr. Johnson's presentation indicated the high interest shown in chemical dehydration as a help in solving problems in air conditioning. Other Features: G. M. Brown, editor of the chapter's new publication, announced the name of the publication as the *Minnesota Exchanger*. Pres. L. C. Gross announced that G. L. Tuve, president of ASHVE, will visit the Chapter during April. A motion was carried that the chapter offer its services to assist the Smoke Abatement Code Committee of the city of Minneapolis. The nominating committee which will select candidates for 1948 officers was appointed. President Gross made a brief report on the activities at the 54th Annual Meeting of the Society. Attendance 72.

MINNESOTA—February 9, 1948. Subject: Newer Developments in Fuels. Speaker: Dr. L. H. Reyerson, assistant dean, school of chemistry, University of Minnesota. Dr. Reyerson emphasized the critical solid and liquid fuel supply in readily available areas throughout the world, and stated that today we are dependent on 3 types of fuel, gas, oil and coal. In 20 years, only a limited supply of gas and oil will be available. Atomic energy is a possible source of unlimited fuel but many years of additional research will be necessary to make this type of fuel feasible. Other Features: Pres. L. C. Gross urged members to attend the exposition and meeting of the Minnesota Federation of Engineering Societies. Guy M. Brown was appointed editor of the Chapter's new publication. Attendance 75.

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MONTREAL—March 1, 1948. Subject: Sound and Acoustics of Air Conditioning and Ventilating Systems. Speaker: T. A. Walters, American Blower Corp., Detroit, Mich. The talk was well illustrated with slides and Mr. Walters traced the development and characteristics of the various types of fans and blower equipment which are being installed in present-day duct systems. Other Features: Pres. T. H. Worthington reported on the success of the last meeting when the annual *curling bonspiel* was held. The following slate of officers was unanimously elected to serve for the coming year: Leo Garneau, *president*, S. W. Salter, *vice president*, R. R. Noyes, *secretary*, W. G. Hole, *treasurer*, and T. H. Worthington, J. P. Fitzsimons, T. G. Anglin, B. J. Horsburgh and J. J. Cosgrove, members of the *board of governors*. Attendance 41.

MONTREAL—February 10, 1948. Subject: History and Development of District Heating in Canada and the United States. Speaker: J. F. Collins, Jr., Secretary *National District Heating Association*. Mr. Collins traced the history and development of district heating both in Canada and the United States. This was a very interesting talk and well received by all the members present. Other Features: Pres. T. H. Worthington appointed members of the nominating committee which will select nominees for 1948 officers. Attendance 37.

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NEBRASKA—February 12, 1948. Kenneth R. Magarrell, vice president of the Nebraska Chapter and Chapter Delegate reported on the activities of the Chapter Delegates meetings during the 54th Annual Meeting. Most of the evening was devoted to suggestions for securing speakers, arranging for better programs, for interesting qualified men to join the Chapter and means of enlarging the Chapter. Attendance 16.

NEBRASKA—January 13, 1948. Subject: A Combination Summer-Winter Air Conditioner. Speaker: Robert Kell, Servel Inc. Mr. Kell thoroughly explained the function, cycle and sequence of operation of a combination summer-winter air conditioner. Charts were used to illustrate the unit. Other features. Frank Prawl of the membership committee gave his report and stated that the next meeting would deal chiefly with the Society's Annual Meeting and with the problem of securing new members. Attendance 41.

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NEW YORK—February 16, 1948. Subject: Thermal Insulation and Condensation in Buildings. Speaker: R. S. Dill, chief, heat and air conditioning section, National Bureau of Standards, Washington, D. C. Mr. Dill explained the equipment and methods used at the Bureau of Standards to determine thermal conductivity and the coefficient of heat transfer. Both the guarded hot plate and guarded hot box methods were described and illustrated by means of slides. Methods of testing various vapor barriers were outlined and results of tests were given to indicate how condensation difficulties could be predicted. Mr. Dill's discussion of the theory of heat transfer through basement walls and concrete floors to the ground was of special interest. Other Features: Pres. M. C. Giannini announced that the Nominating Committee could not report due to the illness of its chairman. An informal report on the activities at the 54th Annual Meeting was given by President Giannini, who expressed the thanks of the chapter to those members who had served on the Committee on Arrangements for the Annual Meeting. Announcements were made of various meetings of the societies affiliated with the Technical Societies Council of New York. Attendance 64. Attendance ratio 0.15.

NEW YORK—January 19, 1948. Subject: Experiences of an International Jury. Speaker: Alfred J. Offner, consulting engineer and past president of ASHVE, New York, N. Y. In giving a history of Turkey

Mr. Offner outlined the changes in the government and the country which led to the selection of Ankara, Turkey, as a location for the Turkish Parliament. He explained the duties of the special three-man International Jury, selected for the purpose of reviewing plans offered in world-wide competition for the mechanical equipment and specifications for the parliamentary buildings. Movies of the interesting scenes and activities noted during his trip to Turkey concluded this excellent presentation. Other Features: New members were introduced and Pres. M. C. Giannini announced the death of Webster Tallmadge on November 24. After J. A. Rice reported as chairman of the Christmas Party Committee, a vote of thanks was given the committee for its excellent work. A nominating committee was appointed by President Giannini, and W. E. Heibel and F. D. McCann reported on plans for the Annual Meeting. Attendance 95. Attendance ratio 0.20.

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NORTH CAROLINA—January 23, 1948. Subject: Condensation in Buildings. Speaker: R. S. Dill, chief, heat and air conditioning section, National Bureau of Standards, Washington, D. C. Members greatly enjoyed Mr. Dill's comprehensive report. Other Features: Several students from North Carolina State College were introduced by Prof. L. L. Vaughan, who stated that a student branch of the ASHVE has been organized at the college. Preliminary plans for the summer meeting were discussed briefly and approved and Pres. E. S. deWitt announced the names of members appointed to the various chapter committees. Attendance 61.

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NORTH TEXAS—March 15, 1948. Subject: Single Phase and Three Phase Motors for Air Conditioning Units. Speaker: Vernon Cox, district manager, Century Electric Co., Dallas, Tex. Mr. Cox gave a very instructive talk on the types, selection and application of both single phase and three phase motors for air conditioning units. Other Features: H. B. Adams, U. S. Electrical Motors, Inc., showed a film of the construction and application of the U.S. Electrical Motors *Varidrive*. S. E. Ammons, president, Texas A. & M. Student Branch, expressed his gratitude to the North Texas Chapter for its assistance in making it possible for three members of the Student Branch to attend the 54th Annual Meeting. An invitation was extended by Mr. Ammons for the North Texas Chapter to join a joint meeting of all the Texas Chapters to be held at College Station on May 11, 1948. Attendance 78.

NORTH TEXAS—February 23, 1948. Subject: Radiant Heating and the Application of the Heat Pump to Small Dwellings. Speaker: Carl F. Boester, director of Housing Research, Purdue University, Lafayette, Ind. A lively discussion period followed Mr. Boester's illustrated talk. Other Features: C. R. Gardner, a past president of the chapter, made a report on the 54th Annual Meeting. Attendance 105.

NORTH TEXAS—January 21, 1948. Subject: Technology Tomorrow. Speaker: Dr. Baldwin M. Woods, president of the ASHVE, and director, University Extension, University of California, Berkeley, Calif. Dr. Woods' timely presentation was greatly enjoyed by those present and many expressed the wish that Dr. Woods appear at a later date and cover any points in his discussion which he was forced to pass over because of lack of time. Other Features: Reports were given by the various committees and a letter from the Student Branch of the Texas A. & M. College was read which expressed the thanks of the Student branch for the $370.00 donated by the North Texas Chapter to help defray the expenses of student members attending the 54th Annual Meeting. Attendance 62.

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NORTHERN OHIO—February 9, 1948. Subject: Film on *Opportunity—Best Location in the Nation*. Speaker: R. C. Heinton, industrial sales manager, sales division of Cleveland Electric Illuminating Co. Mr. Heinton introduced his company's film with a short talk outlining his firm's activity in encouraging industry to move to Northern Ohio. Other Features: Members enjoyed the *coffee talk* given after dinner by W. P. Craig, of the Council on World Affairs. Reports were given by the treasurer and the chairmen of the program and membership committees. Philip Cohen, of the Chapter's Public Affairs Committee, in making a report on the Cleveland Street Car Ventilation System, offered the opinion that the new President Conference Committee cars were well ventilated but the old streetcars were no good and nothing could be done about them. Attendance 66.

NORTHERN OHIO—January 5, 1948. Subject: Heat Transfer to and from Direct Fired Surfaces. Speaker: L. G. Miller, professor, Michigan State College, East Lansing, Mich. Professor Miller's interesting talk was the result of experimental work carried on at Michigan State College on the heat transfer of primary surface in warm air furnaces. Other Features: Jules Eshner, Council of World Affairs, delivered a very interesting *coffee talk*. Vice president Moore reported that the new roster was complete and in the mail, and that an additional $50.00 had been received toward the fund to reduce the mortgage on the Research Laboratory. Attendance 77.

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OKLAHOMA—February 11, 1948. Subject: Blowers and Related Air Handling Equipment. Speaker: L. P. Hanson, vice president in charge of sales, U. S. Air Conditioning Corp., Minneapolis, Minn. Slides showing charts and tables, added to the easy participation of all present in the discussion period which followed this informative talk. Attendance 44. Attendance ratio 0.75.

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ONTARIO—March 1, 1948. Subject: Air Cleaning and Purifying. Speaker: Orm Moffat, manager, special products section, Canadian Westinghouse Co., Ltd. Mr. Moffat illustrated his subject with slides and by an actual demonstration of electric air cleaning. Other Features: Mr. Baxter, chairman of the Canadian Room arrangements at the

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54th Annual Meeting announced a surplus of $153.45. A motion was carried that the Montreal and Winnipeg chapters be notified that the Ontario chapter is in favor of setting this surplus aside toward the fund for a similar room at the next annual meeting. Attendance 71. Attendance ratio 0.37.

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OREGON—March 4, 1948. Subject: Performance Analysis of Heating and Ventilating Installations. Speaker: W. Bruce Morrison, consulting engineer, Portland, Oregon. Mr. Morrison's talk covered hourly recordings made during three days on an industrial building using 12 thermocouple positions, which gave 2880 recordings every 24 hours. The results of the recordings, which checked supply and return water, inside and outside air, wind velocity and some moisture, were compared against the design of the installations. Mr. Morrison's presentation bore out the need of the industry for a program which will cover all the factors over a longer period of time and produce results which could be charted or used in graph form. Other Features: J. H. Bonebrake, chairman of the exhibits committee for the Air Conditioning Conference, announced that requests for exhibit space far exceed supply, while W. A. Simpson, Air Conditioning Conference chairman, announced that arrangements for all technical session speakers have been completed and all space for equipment displays have been assigned. In addition to newspaper space, cards for automobile bumpers, street car advertising and radio announcements will be used to advertise the conference. C. W. Brissenden, chapter president, reported on activities at the 54th Annual Meeting in New York, particularly in reference to technical sessions on heat pump research. The following officers were elected and will take office during April: E. R. Lokey, *president,* J. P. McDermott, *vice president,* A. N. Hoss, *secretary,* J. H. Bonebrake, *treasurer,* and C. W. Brissenden, K. H. Hanson, L. J. Harrington, *board of governors.* Attendance 78.

Oregon Chapter Officers

(L. to R.) *Front*—Pres. E. R. Lokey, Vice Pres. J. P. McDermott, Secy. A. N. Hoss. *Rear*—C. W. Brissenden, K. H. Hanson, Board of Governors, J. H. Bonebrake, Treas.

OREGON—February 5, 1948. Subject: Film on Combined Effect of Temperature and Pressure in Producing Explosions. Speaker: Wayne Janes, Watts Regulator Co. Mr. Janes showed movies of a series of experiments demonstrating the combined effect of temperature and pressure in producing explosions. Other Features: Nominees for 1948 officers were announced by J. A. Freeman, chairman of the nominating committee. A discussion of the events at the 54th Annual Meeting followed with John Bonebrake describing the exhibits, J. D. Kroeker reporting on the technical sessions and E. R. Lokey, chapter delegate, covering the business sessions. Attendance 67.

OREGON—January 8, 1948. Subject: Trends in Heating, Ventilating, and Air Conditioning. Speaker: T. E. Taylor, consulting engineer, Portland, Oregon. In his interesting and informative talk, Mr. Taylor covered a wide field, discussing underground gasification of coal, boiler-burner units with the heat exchanger for warm air heating, panel heating, and the heat pump. Other Features: Ray Chewning, treasurer, discussed the cost of reserving space at Benson Polytechnic School where the Air Conditioning Conference will be held. Reports were given by several of the committee chairmen and A. E. Finlay, chapter historian, announced that he would appreciate information from past officers that could be used in compiling the chapter's history. B. W. Farnes announced the 54th Annual Meeting while E. R. Lokey discussed the proposed joint-Chapter Seattle meeting. A motion was seconded that the Chapter extend an invitation to the Society to hold its summer meeting in Portland in 1950. Attendance 78.

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PACIFIC NORTHWEST—January 13, 1948. Subject: The History and Development of Medicine During the Past Fifty Years. Speaker: Dr. Edward L. Turner, dean of the University of Washington Medical School. Dr. Turner presented his subject in an interesting manner. Other Features: Since this was a joint meeting of the Oregon and Pacific Northwest Chapters, presiding officers of both chapters introduced their guests. Commissioner W. A. Bowes, Portland Office, Public Works Department, praised the work of the Oregon Chapter and its cooperation with the Public Works Department. Prof. E. O. Eastwood outlined the founding and growth of the Oregon Chapter from the time it was organized by its two original members, B. W. Farnes and J. Donald Kroeker. Attendance 85.

PACIFIC NORTHWEST—December 9, 1947. Subject: Panel Heating. Speaker: Prof. E. O. Eastwood, professor mechanical engineering, University of Washington, Seattle, Wash. Prof. Eastwood brought out

many interesting details in his discussion on panel heating and its many ramifications. Other Features: B. W. Farnes, a member of the Oregon Chapter, outlined the scheduled events to be held at the Air Conditioning Conference in Portland. A letter of acceptance from the Oregon Chapter, relative to a joint meeting to be held in Seattle, was read and approved. Attendance 28.

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PHILADELPHIA—February 12, 1948. Subject: The Magic of Electronics. Speaker: Dr. Gordon Volkenant, Minneapolis-Honeywell Regulator Co. Dr. Volkenant's well planned presentation of his subject proved interesting to members and a lively discussion period followed. Other Features: Minutes of a previous meeting and the treasurer's report were read and approved. Attendance 172.

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PITTSBURGH—March 8, 1948. Subject: *You*. Speaker: Theodore F. Hatch, research director, Industrial Hygiene Foundation of America, Inc. Mr. Hatch compared man with a heat engine, and stated that he is subject to the same fundamental laws governing other engines. Man's response to heat can be described or expressed in familiar engineering terms. Coefficients of heat transfer by radiation, convection, and evaporation have been measured. Mr. Hatch discussed the effect of heat in engineering terms on men in the second world war who fought in tanks, what they had to encounter, and the length of time a man could stand these conditions. His talk was illustrated by means of slides, graphs and charts. Other Features: Several Committee reports were given and J. L. McCann reported on a proposed golf meeting to be held with the *ASRE*. B. B. Reilly gave his report as chapter delegate to the 54th Annual Meeting. Attendance 40.

PITTSBURGH — February 9, 1948. Subject: Space and Water Heating Operations of a Large Hotel. Speaker: Albert Buenger, building superintendent, Hotel Gibson, Cincinnati, Ohio. Mr. Buenger discussed the terrific expenses involved in repairing the damages which occur during large meetings, and the difficulties involved in running a large hotel, which sometimes assume the aspect of a *three-ring circus*. His talk was mainly concerned with the space and water heating operations of a hotel and slides were used to show costs of performing work for guest satisfaction, and economy of operation. Other Features: A motion was unanimously carried that the Dravo Corp., the chapter's host at a previous meeting, be offered the thanks of the Pittsburgh Chapter for an interesting and enjoyable meeting. Attendance 31.

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ROCKY MOUNTAIN—February 6, 1948. Subject: The Heat Pump in Large Buildings. Speaker: J. Donald Kroeker, consulting engineer, Portland, Oregon. Mr. Kroeker's illustrated talk proved very interesting to members and their guests. Other Features: Reports were given by the nominating and finance committees. After the report of the legislation and code committee, the Rocky Mountain Gas Association code for gas piping was unanimously approved. It was announced that the *Association* was sponsoring a meeting where the development of gas in the Rocky Mountain area would be discussed. Attendance 37.

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ST. LOUIS—February 11, 1948. Subject: Experiences of a Feature Writer. Speaker: Beulah Schacht, feature writer, St. Louis Globe Democrat. A rising vote of thanks was accorded to Miss Schacht for her most enjoyable discussion. Other Features: Since this was a Ladies Night meeting all official business was suspended. Attendance 80.

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SOUTHERN CALIFORNIA—February 18, 1948. Subject: Air Conditioning Evaluated in Relation to Health. Speaker: Dr. A. V. Nasatir, director of the division of industrial health, Los Angeles City Health Dept. Dr. Nasatir outlined the relation of temperature and humidity to health and also the problems of dust and odors in occupied spaces. Other Features: A report on chapter finances was given by Lloyd Helms. R. A. Lowe, president of the chapter, reported briefly on the 54th Annual Meeting and appointed chairmen for the Code Committee on Heating and the Code Committee on Refrigeration. A. J. Hess reported on progress being made in the formation of a Los Angeles Technical Council. Attendance 66.

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SOUTH TEXAS—February 20, 1948. Subject: Reverse Cycle for Home Air Conditioning. Speaker: Carl F. Boester, director, housing research, Purdue Research Foundation, Purdue University, Lafayette, Ind. Mr. Boester was given a great ovation for his fine talk. Other Features: Reg. F. Taylor was praised for his outstanding work as a member of the Council by Mr. Boester, who also urged members to attend the Semi-Annual Meeting of the Society. An announcement was made that a joint meeting of the engineering societies of Houston will be held at the Rice Hotel April 30, 1948. B. P. Fisher reported on an Air Conditioning Short Course which will be held at the Texas A. & M. College April 26 to 28. Prof. Wayne Long gave a short report on the participation of student delegates from the Texas A. & M. Student Branch in the 54th Annual Meeting. Robert Salinger gave his report as treasurer. Attendance 81.

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VIRGINIA—January 29, 1948. Officers for 1948 were elected as follows: William H. Webster, Jr., *president*, Jesse E. White, *vice president*, D'Arcy E. Phillips, *secretary*, William G. Hayes, *treasurer*. After the newly elected president, Mr. Webster, made an address of acceptance, members of the various committees were appointed.

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WASHINGTON, D. C.—February 11, 1948. Joint Meeting of the Balti-

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more-Washington Section of the *ASRE* and the Washington chapter of the ASHVE. Subject: What I Hear in Washington. Speaker: Paul D. Wooton, columnist of *Nation's Business* and of many American newspapers. Mr. Wooton divided his talk into two parts, an explanation of the country's economic position and a view of the political scene. The interest of the members in Mr. Wooton's presentation was indicated by the lively discussion period which followed each part of his talk. Other Features: Harry Baker, a professional entertainer, provided members with an enjoyable half hour with his sleight-of-hand magic. Attendance 133.

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WESTERN MICHIGAN—February 9, 1948. Subject: Activities at the 54th Annual Meeting, ASHVE, New York, N. Y. H. R. Limbacher, chapter delegate to the Annual Meeting, discussed the new past presidents' pins, which he asked the chapter to consider, and recommended that chapter delegates' minutes be kept by the secretary for reference by new delegates. He also urged that members contribute further to eliminate the balance of the mortgage on the Research Laboratory. Pres. Frank Harbin gave a detailed picture of the Heating and Ventilating Exposition, particularly in reference to exhibits on the *Jetronic Oil Burner*, and the room temperature adjustable register. L. A. Calcaterra also reported on the *Jetronic Oil Burner* and gave his observations on the heat pump exhibits. Reports on technical papers were given by K. E. Robinson, Prof. L. G. Miller, and H. R. Limbacher, and F. K. Platt. A report on the Society activities at the meeting, including the Annual Banquet, was given by S. H. Downs. Attendance 50. Attendance ratio 0.60.

WESTERN MICHIGAN—January 12, 1948. Subject: Old and New Holland. Speaker: Dr. C. DeGraaf, in charge of the English Dept., Hope College, Holland. Dr. DeGraaf covered the two great struggles of the Netherlands. One of these struggles is the great engineering accomplishment of reclaiming land from the sea. The other is the struggle for existence because of the great number of wars which have been fought in or around the Netherlands' borders. This instructive talk was appreciated by all. Other Features: Since this was ladies' night, a special Dutch hospitality atmosphere was created, with the officers and their wives attired in original Dutch costumes. Attendance 72. Attendance ratio 0.84.

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WESTERN NEW YORK—February 9, 1948. Subject: Heat Output of Various Types of Panel Construction. Speaker: William Chapman, director of panel heating research, National Tube Co. Mr. Chapman spoke on the tests which his company and the ASHVE are conducting on the heat output of various types of panel construction. A report on the chapter's fund for reducing the mortgage on the Research Laboratory was given by J. M. Quackenbush and B. C. Candee, and Roswell Farnham reported on the 54th Annual Meeting. Attendance 51. Attendance ratio 0.77.

WESTERN NEW YORK—January 12, 1948. Investigations made by the Buffalo Better Business Bureau. Speaker: Roscoe C. Ridee, merchandise manager, Buffalo Better Business Bureau. Mr. Ridee discussed the checks and investigations made by his office to halt the malicious practices in overselling the public on heating and insulation materials. Other Features: Pres. G. E. Adema reported that approximately $600.00 had been contributed by the chapter toward the fund to reduce the mortgage on the Research Laboratory. Negotiations for a joint meeting with the Toronto Chapter of the ASHVE were also announced. Attendance 36. Attendance ratio 0.60.

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WISCONSIN—February 18, 1948. Subject: The Best in Science is Yet to Come. Speaker: Dr. Gerald Wendt, editorial director, Science Illustrated Magazine. Dr. Wendt indicated the progress of research in his talk and gave his audience a look into our probable scientific future. Other Features: The death of Walter Lambeck, a member of the Chapter, on February 3, 1948, was announced and a resolution expressing the chapter's sympathy was sent to his widow. Attendance 265.

Student Branch

TEXAS A. & M.—March 4, 1948. Subject: Summer Employment. Wayne Long briefly outlined the advantages which summer employment offers the student and gave the location and availability of some of the openings. L. W. Thompson, chairman of the placement committee, outlined the procedure of the committee in obtaining interviews with prospective employers and passed out application blanks to those interested. Messrs. Ammons, Burns, Manget, and Thompson gave an outline of the type of jobs they had held during the past summer and the possible salaries that might be expected. Other Features: Pres. S. E. Ammons announced that all those able to play in the Engineers' Day Follies Band should list their names with the Student Engineers Council. R. H. Phillips reported that the Engineers' Day committee was making progress and two more men were appointed to assist Mr. Phillips with the program to be presented at that time. A discussion of a proposed joint meeting of the three Texas Chapters was held, and the date for the meeting was tentatively chosen as May 4 or May 11. Attendance 45.

TEXAS A. & M.—February 19, 1948. Subject: 54th Annual Meeting ASHVE, New York, N. Y. T. V. Burns, vice president, was the first speaker of the evening. Mr. Burns gave a general report of the meeting, and stated that the student delegates were well received and that great interest was shown in the Student Branch. Pres. S. E. Ammons then reviewed two papers on the heat pump which had been presented at technical sessions. Other Features: An invitation for

all student members to attend the short course in air conditioning, which will be given at the Texas A. & M. College and sponsored by the ASHVE, was extended by Pres. S. E. Ammons. The possibility of holding a joint meeting with all the Texas chapters participating was then discussed. Attendance 24.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 123 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by May 20, 1948, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

ADASKA, JOHN JR., Student, University of Illinois. PROPOSERS: J. R. Carroll, Jr., R. J. Martin*. SECONDERS: A. Buckley, S. Konzo.

ALBRECHT, CHARLES N., Sales & General Mgr., Bond Supply Co. PROPOSERS: T. D. Stafford, D. R. Schilken. SECONDERS: O. D. Marshall, J. L. Alexander.

ALEXANDER, FRANK S. JR., Graduate Student, University of Illinois. PROPOSERS: S. Konzo, N. S. Buckley. SECONDERS: J. R. Fellows, J. R. Carroll, Jr.

ASTROVE, ALAN, Student, University of Michigan. PROPOSERS: Axel Marin, F. N. Calhoon. SECONDERS: C. F. Kessler, A. B. Epple.

BELFORD, LOUIS B., Regional Mgr., Air Cond. Controls Div., Minneapolis-Honeywell Regulator Co. PROPOSERS: C. S. Koehler, O. F. Quist, Jr. SECONDERS: Ernst Graber, J. R. Bergan. *(Advancement)*

BERGER, FRED W., JR., Sales Engr., Parker Building Specialties, Inc. PROPOSERS: Karl Baldwin, Jr., D. F. Owens. SECONDERS: R. A. Parker, T. J. White.

BERGTHOLDT, GEORGE C., Chief Engr., The Webster Engineering Co. PROPOSERS: W. R. Lee, F. M. Thomas. SECONDERS: Edwin Jones, A. D. Holmes.

BLACK, SAMUEL W., JR., Engr., Metropolitan Utilities District. PROPOSERS: Verne Simmonds, O. J. Smith. SECONDERS: C. A. Goth, B. G. Peterson.

BOCCI, PAUL P., Sales Engr., U. S. Radiator Corp. PROPOSERS: R. F. Connell, C. F. Donohoe. SECONDERS: A. A. Emrick, A. E. Knibb.

BODANZKY, HANS R., Chief Engr., Starco, Ltda. PROPOSERS: E. R. Becraft, R. G. Lubinsky. SECONDERS: R. E. Lucey, C. L. Ringquist.

BOLLMAN, ROGER T., Serv. & Install. Mgr., Minneapolis-Honeywell Regulator Co. PROPOSERS: E. L. Crosby, R. L. Leilich. SECONDERS: F. S. MacGann, F. A. Leser.

BONCKE, GORDON C., Prod. Engr., E. I. du Pont de Nemours & Co. PROPOSERS: R. E. Cherne, N. E. Sheldon. SECONDERS: C. H. Urlaub*, W. J. Grunst*.

BOONE, WILLIAM A., Asst. Sales Mgr., Bell & Gossett Co. PROPOSERS: E. J. Gossett, R. E. Moore. SECONDERS: F. W. Thompson, G. W. Bornquist.

BOTENSTEN, WILLIAM F., Sales Engr., The Pyle National Co. PROPOSERS: G. K. Raider, W. M. Nesteruk. SECONDERS: C. H. Bevington, G. F. Nightingale.

BRACEWELL, LORAINE M. JR., Student, A. & M. College of Texas. PROPOSERS: W. E. Long, G. R. Tippett. SECONDERS: A. V. Brewer*, C. M. Cimmang*.

BROWN, CHARLES V., Student, A. & M. College of Texas. PROPOSERS: W. E. Long, G. R. Tippett. SECONDERS: A. V. Brewer, C. M. Cimmang*.

BROWN, G. WESLEY, V. P. & Sales Mgr., Southern Furnace & Supply Co. PROPOSERS: C. A. McKinney, D. M. Mills. SECONDERS: B. P. Fisher, H. W. Presseur.

BROWN, LEONARD, Chief Draftsman, H. S. Haley, Cons. Engr. PROPOSERS: H. S. Haley, Philip Molfino. SECONDERS: F. J. White, L. H. Cochran.

CHADWICK, FRED W., Owner, F. W. Chadwick Co., Sales Engrs. PROPOSERS: J. W. Stevens, C. F. Mally. SECONDERS: C. W. Nessell, G. F. Keane.

CHRISTMANN, WILLIAM F., Engr., Kroeschell Engineering Co. PROPOSERS: A. H. Goelz, M. R. Derby. SECONDERS: S. S. Sommerfield, M. J. Bamond. *(Advancement)*

COX, WILLIAM G., Asst. to Sales Mgr., General Electric Co. PROPOSERS: F. H. Faust, F. O. Urban*. SECONDERS: W. F. R. Karsten, D. W. McLenegan.

CROOHE, ARNOLD L., Sales Engr., Wm. W. Short Co., Inc. PROPOSERS: M. C. Giannini, J. E. Schechter. SECONDERS: R. L. Stinard, A. A. Giannini.

DAVIS, TITUS E., Vice-Pres., Engineering & Sales Co. PROPOSERS: Verne Simmonds, C. A. Carter. SECONDERS: K. E. Martin, F. E. Prawl.

DAY, GEORGE W., Mgr., Koolshade & Storm Shade Dept., Ingersoll Steel Div., Borg-Warner Corp. PROPOSERS: L. T. Avery, J. E. Wilhelm. SECONDERS: Dennis Boggs, J. M. Black.

DEWITT, STUART L., Student, Michigan State College. PROPOSERS: C. H. Pesterfield, L. G. Miller. SECONDERS: James T. Anderson, P. J. Vanderlip.

DOWNS, FRED, Estimator, Dallas Plumbing Co. PROPOSERS: R. W. Hanson, J. V. Edmondson. SECONDERS: J. P. Ashcraft, Oslin Nation.

EDSON, WARREN N., Director, School of Plumbing, Heating & Air Cond., International Correspondence Schools. PROPOSERS: David Jones*, B. B. Mahon. SECONDERS: Samuel Baker*, W. N. Richards*.

ELLIS, LESTER W., Dist. Repr. PROPOSERS: J. H. Carnahan, J. R. Patten. SECONDERS: J. H. Spaan, G. T. Donceel. *(Reinstatement & Advancement)*

EVANS, RAOUL C., Engr., Campbell-Elsey Co. PROPOSERS: G. C. Campbell, R. A. Pons. SECONDERS: A. R. Curtis, E. V. Gritton.

FERGUSON, LAWRENCE A., Sales, Magarrell & Co. PROPOSERS: K. R. Magarrell, Verne Simmonds. SECONDERS: C. A. Carter, B. G. Peterson.

FINK, HERBERT D., Sec'y & Supvsr. Engrg. Dept., Stuart Cooling Corp. of Florida. PROPOSERS: C. B. Smoot, M. C. Connell. SECONDERS: Armand Cowan, R. P Kelley.

*Non-Member

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GILMORE, CLARENCE F., Jr. Engr., Dallas Air Conditioning Co. PROPOSERS: T. H. Anspacher, J. A. Ray. SECONDERS: B. G. Mercer, A. F. Avera. *(Advancement)*

GLICKMAN, NATHANIEL, Asst. Prof. Medicine & Research Physiologist, University of Illinois Medical School. PROPOSERS: R. C. Cross, E. P. Heckel. SECONDERS: C. M. Burnam, Jr., M. K. Fahnestock.

HANLEN, PAUL M., Student, David Ranken Jr. School of Mechanical Trades. PROPOSERS: J. T. Lynch, G. B. Rodenheiser. SECONDERS: C. O. May, F. M. Todd*.

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WRIGHT, JAMES W., Student, Michigan College of Mining & Technology. PROPOSERS: F. E. Wittig, E. L. Sitz*. SECONDERS: W. C. Polkinghorne*, A. P. Young*.

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JOURNAL SECTION

Candidates Elected

In the past issues of the JOURNAL of the Society the names of the following men were listed as Candidates for Membership. The membership grade of each Candidate has been assigned by the Committee on Admission and Advancement and balloted upon by the Council. We are now instructed by the Council to post herewith, as required by Art. B-III, *Section* 8, of the By-Laws, the following list of candidates elected:

Members

BAUMAN, CARL S., Exec. Engr., Tex-Air Conditioning Co., Fort Worth, Tex.

BAUMANN, ARNOLD W., Chief Engr., Arthur Harris & Co., Chicago, Ill.

BROWN, HENRY C., Jr., Section Head Res. Lab'y., Armstrong Cork Co., Lancaster, Pa.

BROWN, ROBERT L., Associate Member, Smithey & Boynton, Roanoke, Va.

HUGHES, JAMES W., Gen. Elec'l. Engr., Canadian Pacific Ry., Montreal, Canada

KELLOGG, WINSTON T., Design Engr., The E. R. Little Co., Inc., Detroit, Mich. (*Advancement*)

LEIGH, RICHARD S., Project Engr., Chase Brass & Copper Co., Waterbury, Conn.

PARODI, H., Cons. Engr., Syndicat National de la Construction Electrique, Paris, France

SCHLENTNER, KARL O., Asst. Mgr. Research, The National Radiator Co., Johnstown, Pa.

SIGEL, ROBERT J., Sales Engr., York Corp., Philadelphia, Pa.

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BOSTON, E. B., Pres., Air Products Equipment Co., Chicago, Ill.

BURKE, T. F., Owner, Thos. F. Burke Co., Washington, D. C.

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CLARK, R. J., Estimator, B. A. Walterman Co., Cincinnati, Ohio

DIAS, W. B., Owens-Corning Fiberglas Corp., New York, N. Y.

DUMONT, VALMORE, Dumont Plumbing Service, Ltd., Ottawa, Ont., Canada

EDWARDS, RAYMOND L., Mech. Engr., Austin Co., Oakland, Calif.

EIBLING, JAMES A., Res. Engr., Battelle Memorial Institute, Columbus, Ohio

FARAGO, WILLIAM J., Mech. Engr., Dominion Electrohome Ind. Ltd., Kitchener, Ont.

FARRAR, JOSEPH L., Estimator, Lent's Plumbing & Heating, Bremerton, Wash.

FREAN, FREDERICK C., Tech. Dir., The Air Treatment Engrg. Co., Ltd., Leeds, England

HOCHSCHULZ, ALFRED, Owner, Moto Ventilating Co., Chicago.

HUGHES, MALCOLM W., Treas., Alfred J. Hunter & Co., Muskegon, Mich.

JENNY, THOMAS J., Air Cond. Sales Engr., Gulf Engineering Co., Inc., New Orleans, La.

KINGDON, FRANK W., Engrg. Draftsman, Ontario Paper Co., Ltd. Thorold, Ont., Canada

LINDEN, MORRIS, Owner, Linden Heating Co., Anoka, Minn.

MACLEAN, R. M., Mech. Engr., Socony Vacuum, Paulsboro, N. J.

MACQUEEN, DONALD, Pres., Donald MacQueen Co., Ltd., Montreal, Que., Canada

NEWBANKS, NILES N., Skelly Oil Co., Kansas City, Mo.

OTTO, ALFRED H., Mgr., Air Cond. Refrig. Dept., Shreveport Plumbing Co., Shreveport, La.

PARKS, WILLIAM N., Mfrs. Agent, Minneapolis, Minn. (*Reinstatement*)

PENAFEATHER, J. C., Const. Supt., Carrier Corp., Syracuse, N. Y.

POTVIN, LEO J., Owner, Fenner & Potvin, Chicago, Ill. (*Reinstatement*)

REED, C. E., Vice Pres., Reed Unit-Fans, Inc., New Orleans, La.

SCOTT, PHILIP R., Cons. Engr., Gutteridge, Haskins & Davey, Melbourne, Australia

SCRIBNER, EUGENE D., Engr., Lancaster, Pa. (*Reinstatement*)

SMITH, C. WARNER, Middle Atlantic Dist. Mgr., Philadelphia, Pa. (*Reinstatement*)

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AREY, HERBERT L.
AUTRY, VON JR.
BEAMAN, BRUCE E.
BEAN, RICHARD F.
BERMAN, RALPH I.
CARPENTER, T. B.
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Publication—John James, *Chairman;* R. S. Dill, S. S. Sanford, R. D. Madison, *Ex-Officio.*

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ASHVE Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio (Tel.: EXpress 6161)

L. N. Hunter, *Chairman* R. D. Madison, *Vice Chairman*
Cyril Tasker, *Director of Research* A. C. Fieldner, *Ex-Officio*

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Two Years: R. C. Cross, M. K. Fahnestock, John James, F. J. Kurth, T. H. Urdahl.

One Year: L. N. Hunter, C. O. Mackey, R. D. Madison, L. G. Miller, L. P. Saunders.

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Connecticut	P. D. Bemis	A. J. Lawless	Oregon	E. R. Lokey	C. W. Brissenden
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Central New York: Organized 1944. Headquarters, Syracuse, N. Y. President, H. G. Strong, 300 S. Geddes St., Syracuse 1. Secretary, G. F. Keane, 316 Haddonfield Dr., DeWitt, N. Y.

Central Ohio: Organized, 1944. Headquarters, Columbus, Ohio. Meets, Third Monday. President, R. B. Breneman, 1282 Edgehill Rd., Columbus 8. Secretary, A. E. Norman, Jr., 1150 Chesapeake Ave., Columbus.

Cincinnati: Organized 1932. Headquarters, Cincinnati. Ohio. Meets First Tuesday. President, H. K. Jennings, 1639 Union Trust Bldg., Cincinnati 2. Secretary, K. B. Little, 832 Temple Bar Bldg., Cincinnati 2.

Connecticut: Organized, 1940. Headquarters, New Haven, Conn. President, S. R. Osborne, Waterbury 91. Secretary, Winfield Roeder, 405 Temple St., New Haven.

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Delta: Organized, 1939. Headquarters, New Orleans, La. Meets, Second Tuesday. President, J. S. Burke, 317 Baronne St., New Orleans 9. Secretary, R. B. Guest, 827 Dryades St., New Orleans 13.

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Golden Gate: Organized, 1937. Headquarters, San Francisco, Calif. Meets, First Wednesday. President, F. W. Kolb, 598 Monadnock Bldg., San Francisco 5. Secretary, K. F. Baldwin, Jr., 419 Kentucky Ave., Berkeley 7.

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Illinois: Organized. 1906. Headquarters, Chicago, Ill. Meets, Second Monday. President, W. A. Kuechenberg, 1714 Sheffield Ave., Chicago 14. Secretary, G. W. Bornquist, 629 W. Washington Blvd., Chicago 6.

Indiana: Organized, 1943. Headquarters, Indianapolis, Ind. Meets, Fourth Friday. President, I. W. Cotton, 1035 N. Pennsylvania St., Indianapolis 4. Secretary, W. R. Fenstermaker, 215 E. New York St., Indianapolis 4.

Iowa: Organized, 1940. Headquarters, Des Moines, Ia. Meets, Second Tuesday. President, C. A. Wheeler, 1217 Grand Ave., Des Moines. Secretary, D. E. Wells, 304 Home Federal Bldg., Des Moines 9.

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Kansas City: Organized, 1917. Headquarters, Kansas City, Mo. Meets, First Monday. President, P. C. Leffel, 3323 Main St., Kansas City 2. Secretary, Henry Nottberg, Jr., 914 Campbell, Kansas City.

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Manitoba: Organized, 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, D. S. Swain, 1186 Downing St., Winnipeg. Secretary, A. W. Moss, 268 Yale Ave., Norwood, Manitoba.

Massachusetts: Organized, 1912. Headquarters, Boston, Mass. Meets, Third Tuesday. President, Adolph Ehrenzeller, 329 Washington St., Dorchester 21. Secretary, R. T. Kern, 51 Claflin St., Leominster.

Memphis: Organized, 1944. Headquarters, Memphis, Tenn. Meets, First Monday. President, N. C. Ledbetter, 22 S. Cooper St., Memphis 4. Secretary, A. T. Bevil, 1521 Waverly Ave., Memphis 6.

Michigan: Organized, 1916. Headquarters, Detroit, Mich. Meets, First Monday after 10th of month. President, A. E. Knibb, 1003 Maryland Ave., Detroit 30. Secretary, L. A. Burch, 5853 Hamilton Ave., Detroit 2.

Minnesota: Organized, 1918. Headquarters, Minneapolis, Minn. Meets, First Monday. President, L. C. Gross, 5324 Oaklawn Ave., Minneapolis 10. Secretary, L. J. Krause, 2753 4th Avenue S., Minneapolis 8.

Montreal: Organized, 1936. Headquarters, Montreal, Que., Canada. Meets, Third Monday. President, Leo Garneau, 25 Salisbury Rd., Pointe Claire, Que. Secretary, R. R. Noyes, 630 Dorchester St., W. Montreal.

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Nebraska: Organized, 1940. Headquarters, Omaha, Neb. Meets, Second Tuesday. President, Verne Simmonds, 2416 Vane St., Omaha. Secretary, G. W. Colburn, 106 N. 15th St., Omaha 2.

New York: Organized, 1911. Headquarters, New York, N. Y. Meets, Third Monday. President, A. A. Bearman, 444 West 56th St., New York 19. Secretary, Carl H. Flink, Room 3000, 51 Madison Ave., New York 10.

North Carolina: Organized, 1939. Headquarters, Durham, N. C. Meets, Quarterly. President, E. S. deWitt, 1211 Commercial Bank Bldg. Charlotte. Secretary, R. M. Warren, Jr., 1001 N. Church St., Charlotte 1.

North Texas: Organized, 1938. Headquarters, Dallas, Tex. Meets Third Monday. President, B. S. Foss, Jr., 711 Construction Bldg. Dallas 1. Secretary, Herman Blum, Jr., 2812 Fairmount St., Dallas 4.

Northern Ohio: Organized, 1916. Headquarters, Cleveland, Ohio. Meets, Second Monday. President, John James, 3170 W. 106th St. Cleveland 11. Secretary, W. M. Rowe, 1302 Swetland Bldg. Cleveland 15.

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Oklahoma: Organized, 1935. Headquarters, Oklahoma City, Okla. Meets, Second Monday. President, W. W. Frankfurt, 519 Apco Tower, Oklahoma City. Secretary, J. H. Spaan, Jr., 1303 N. Klein, Oklahoma City 6.

Ontario: Organized, 1922. Headquarters, Toronto, Ont., Canada. Meets, First Monday. President, D. A. Stott, 195 Spadina Ave. Toronto. Secretary, H. R. Roth, 57 Bloor St., W., Toronto, Ont.

Oregon: Organized, 1939. Headquarters, Portland, Ore. Meets Thursday after First Tuesday. President, E. R. Lokey, 1238 N. W. Glisan St., Portland 9. Secretary, A. N. Hoss, 621 S. W. Alder, Portland.

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Pacific Northwest: Organized, 1928. Headquarters, Seattle, Wash. Meets, Second Tuesday. President, E. H. Langdon, 72 Vine St., Seattle. Secretary, E. J. Rosen, 10238 18th Ave., S. W., Seattle 66.

Philadelphia: Organized, 1916. Headquarters, Philadelphia, Pa. Meets, Second Thursday. President, J. O. Kirkbride, Fourth & Locust Sts., Philadelphia 6. Secretary, M. E. Barnard, 12 S. 12th St., Philadelphia 7.

Pittsburgh: Organized, 1919. Headquarters, Pittsburgh, Pa. Meets Second Monday. President, D. W. Loucks, 435 Sixth Ave., Pittsburgh 19. Secretary, E. H. Riesmeyer, Jr., 231-33 Water St., Pittsburgh 22.

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Rocky Mountain: Organized, 1944. Headquarters, Denver, Colo. Meets, First Wednesday. President, Fred Janssen, 1123 W. Third Ave. Denver 9. Secretary, F. C. Allen, 4467 King St., Denver 11.

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St. Louis: Organized, 1918. Headquarters, St. Louis, Mo. Meets First Tuesday. President, B. L. Evans, 571 Stratford Ave., University City. Secretary, C. H. Burnap, 1635 Syndicate Trust Bldg., St. Louis 1.

South Texas: Organized, 1938. Headquarters, Houston, Tex. Meets, Third Friday. President, D. M. Mills, Gray and Crawford, Houston 3. Secretary, L. L. Ladewig, Box 1188, Houston 1.

Southern California: Organized, 1930. Headquarters, Los Angeles, Calif. Meets, Third Wednesday. President, R. A. Lowe, 6381 Hollywood Blvd., Los Angeles 28. Secretary, John L. Blake, 1700 S. Bedford St., Los Angeles 35.

Southwest Texas: Organized, 1946. Headquarters, San Antonio, Tex. President, F. C. Benham, Jr., 702 S. Flores St., San Antonio. Secretary, L. S. Pawkett, 810 Insurance Bldg., San Antonio 5.

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Utah: Organized, 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, E. V. Gritton, 2470 S. 15th, Salt Lake City 5. Secretary, C. E. Ferguson, 838 Garfield Ave., Salt Lake City.

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Virginia: Organized, 1946. Headquarters, Norfolk, Va. President, W. H. Webster, Jr., 933 W. 21st St., Norfolk. Secretary, D. E. Phillips, P. O. Box 674, Newport News.

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Washington, D. C.: Organized, 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. President, H. H. Hill, 438 Woodward Bldg., Washington 5. Secretary, J. G. Muirheid, 2013 New Hampshire Ave., N. W., Washington 9

Western Michigan: Organized, 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. President, Frank Harbin, Jr., 280 E. 6th St., Holland. Secretary, W. C. DeRoo, 500 E. 8th St., Holland.

Western New York: Organized, 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. President, G. E. Adema, 39 W. Balcom St. Buffalo 9. Secretary, J. H. Bryce, 88 E. Girard Blvd., Kenmore.

Wisconsin: Organized, 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. President, J. R. Vernon, 507 E. Michigan St., Milwaukee 2. Secretary, B. M. Kluge, 1817 S. 66th St., Milwaukee 14.

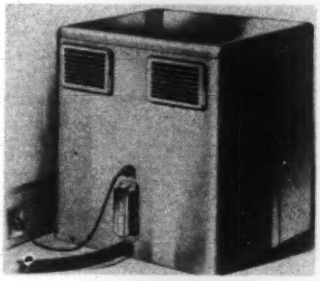
Student Branch

Texas A. & M. College: Organized, 1946. Headquarters, College Station, Tex. Meets, Third Thursday. President, S. E. Ammons, 212 13th Ave., No., Texas City. Secretary, C. P. Howard, Box 1706, College Station.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1948 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

New Dehumidifying Unit Uses Solid Adsorption Desiccant



No. 3745—Dry Air Products Corp., 734 Jackson Pl., N. W., Washington, D. C., has announced two new "DryNamic" dehumidifiers for reduction of relative humidity in storage spaces, stock rooms, basements, etc. for the prevention of corrosion, rust, and mildew formation.

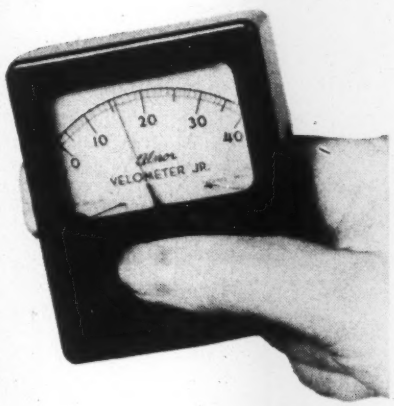
The new units are of the solid adsorption dessicant type and are automatic and electrically operated. Dry air is discharged from the units into the space to be dehumidified and wet air is exhausted through a flexible hose line to the outside of the room. Control is available by means of a plug-in humidistat in the unit.

The new dehumidifiers are designated model Q and QD. Model Q is a single bed machine with intermittent cycles of adsorption and reactivation. Having a moisture removal capacity of 12 lb per day, it is said to be suitable for spaces up to 5000 cu ft, depending on desired final conditions and the tightness of the structure.

Model QD, shown here, is a double bed unit with continuous adsorption. One bed is used for adsorption, while the other bed is being reactivated. This unit may be used for spaces up to 15,000 cu ft and has a moisture removal capacity of 24 lb per day.

The dehumidifiers are sold by Dry Air Products Corp. and by the manufacturer, DryNamic Div., Cargocaire Engineering Corp., 15 Park Row, New York 7, N. Y.

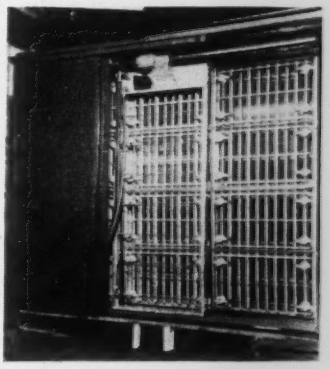
Develops Small Sized Instrument for Measuring Air Velocities



No. 3746—A new miniature "Alnor Velometer Jr.," recently announced by Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago, is said to be a portable, low priced, direct reading instrument, giving instantaneous and precise measurements of air velocities in unrestricted areas.

This palm-sized meter is designed for heating, ventilating, air conditioning, and refrigerating work not requiring the use of jet attachments. Completely self contained, it is 4 in. high, 3 in. wide, and 1½ in. deep. It has single or double velocity range scales and is calibrated to provide direct readings in either feet per minute or miles per hour. A leather carrying case with brass fittings is also available for added protection and convenience when handling the instrument.

Automatic Washing Unit Used on Industrial Precipitators



No. 3747—A new fully automatic electronic precipitator, offered by Raytheon Mfg. Co., Waltham, Mass., was introduced at the 8th International Heating, Ventilating, and Air Conditioning Exposition.

A new washing unit is incorporated and is designed to automatically wash and dry all ionizers and collector plates, to re-apply the adhesive, and to shut off automatically. According to the company, no cleaning maintenance is required and service of the precipitator is not interrupted. In the illustration shown here, baffle doors have been opened and louvers removed from the automatic washer unit to show construction details.

To Market Silicone Rubber Compound

No. 3748*—General Electric Co.'s chemical department, Pittsfield, Mass., is marketing seven standard grades of silicone rubber molding compounds to molders and fabricators. All stocks are designed to withstand temperatures ranging from —70 to 520 F and to have excellent electrical and chemical properties.

Stocks available include both molding and extruding compounds which may be processed in customary pro-

[*Continued on page 200*]

Heating, Piping & Air Conditioning [5-48]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

3745	3746	3747	3748	3749	3750	3751	3752	3753	3754
3755	3756	3757	3758	3759	3760	3761	3762	3763	3764
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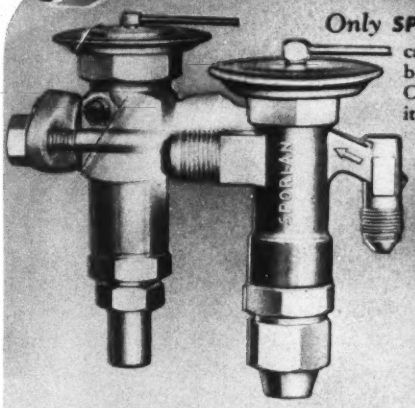
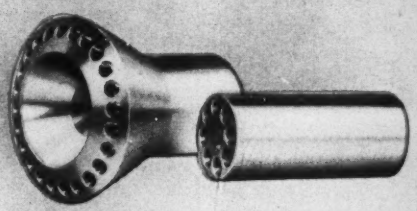
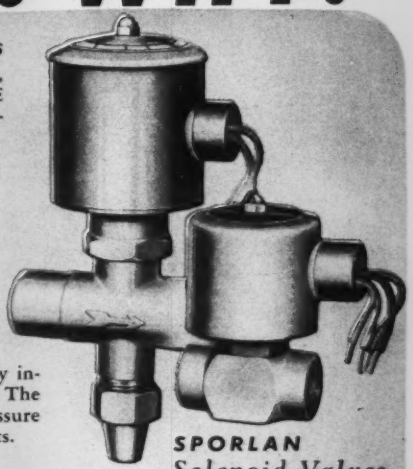


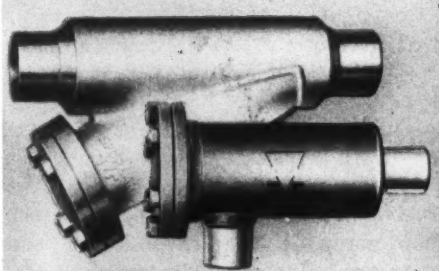
Only **SPORLAN** *Thermostatic Expansion Valves* can give you Peak Performance on all installations, because only Sporlan offers you SELECTIVE CHARGES. Each charge is designed to fit a definite condition.



You'll Get Peak Performance on every installation you make with Sporlan Distributors. The perfectly designed nozzle and conical button assure even distribution regardless of number of outlets.

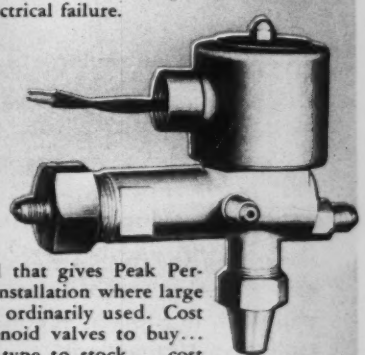


SPORLAN *Solenoid Valves* will give you Peak Performance on all installations too, because the Sporlan Solenoid Coil is so well insulated...so moisture proof, that it defies electrical failure.



SPORLAN *Strainers* are Peak Performers too, because they are designed better... precision built to closer tolerances, and contain the best materials obtainable.

Only **SPORLAN** *Catch-Alls can give you Peak Performance on all installations, for only the Catch-All* has a porous molded cylinder. It cannot powder! It cannot pack! It dries the refrigerant to an extremely low end point. A point so low that any remaining moisture is absolutely harmless.



Only **SPORLAN** *offers you the Solenoid Pilot Control,* a patented control that gives Peak Performance on every installation where large solenoid valves are ordinarily used. Cost less than large solenoid valves to buy... only one size and type to stock . cost less than large solenoid valves to install.

Place your next order with your Sporlan Wholesaler and get Sporlan throughout.

You'll see why Engineers everywhere recommend **PEAK PERFORMANCE SPORLAN PRODUCTS!**

SPORLAN VALVE CO.

7525 SUSSEX AVENUE **ST. LOUIS 17, MISSOURI**

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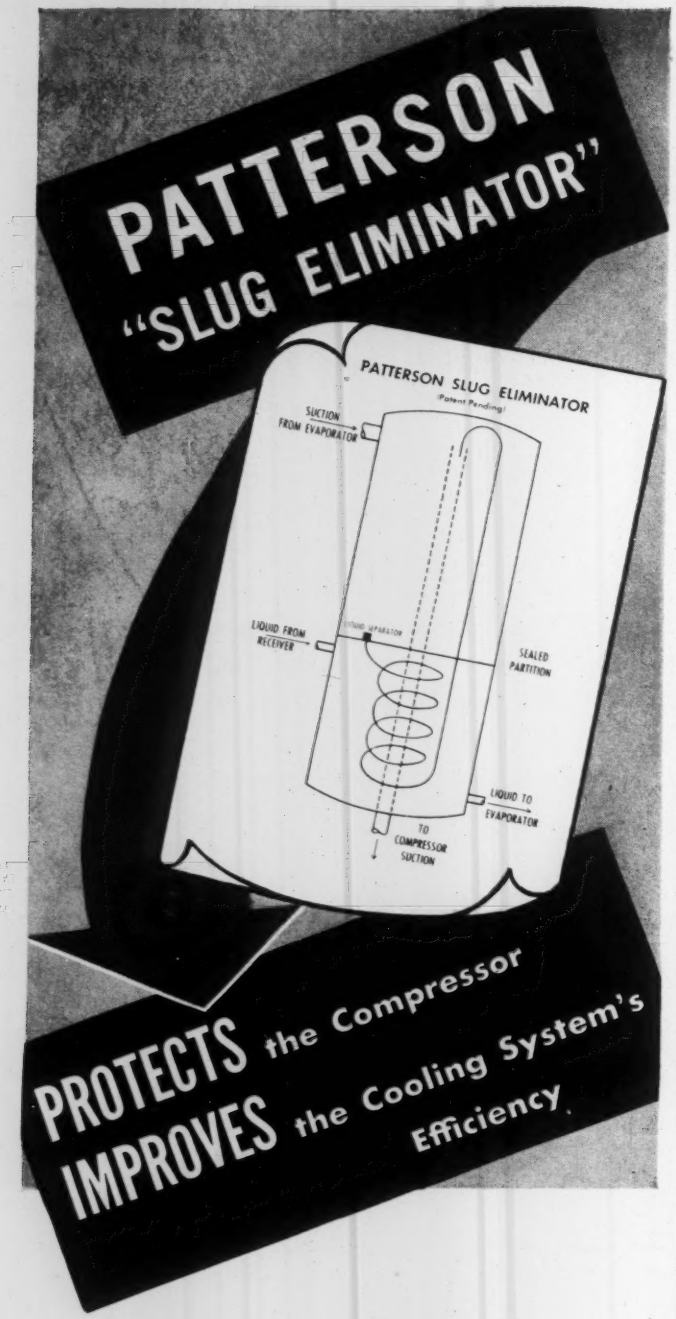


Order it for your cooler . . . existing or proposed.

The Patterson "Slug Eliminator" is positive in its liquid trapping action and by sub-cooling the refrigerant improves the efficiency of the system. It is simple and effective and has only one moving part — the separating valve.

In writing for further details, including prices and delivery, describe fully the cooler setup you wish to protect. We might have some installation suggestions.

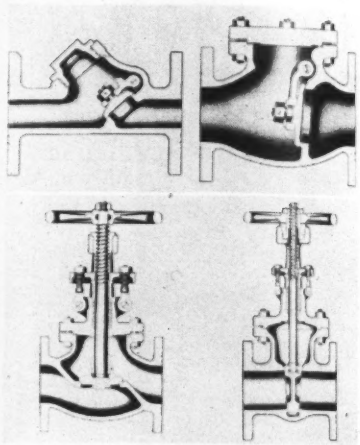
THE PATTERSON-KELLEY Company, Inc.
107 WARREN STREET, EAST STROUDSBURG, PA.
NEW YORK 17—101 Park Ave. PHILADELPHIA 3—1700 Walnut St.
CHICAGO 4—Railway Exch. Bldg. BOSTON 16—96-A Huntington Ave.
Representatives in Principal Cities

[*Continued from page 191*]

duction equipment. These include extrusion stocks in white, a molding stock in white, brown stocks for both extrusion and molding, and a white stock for both extrusion and molding.

According to the company, the compounds, now used principally as gaskets in various types of industrial equipment, have many advantages including heat resistance, nonadherence to metal surfaces, good gasketing action because of low compression set and stability of surface hardness and resilience. The materials do not tend to cold flow nor vulcanize at room temperature, it is said. Stocks can be reinforced for additional strength.

Develops Line of Corrosion Resistant Globe, Gate, and Swing Check Valves



No. 3749—Crane Co., 836 S. Michigan Ave., Chicago, has announced new lines of corrosion resistant alloy globe, gate, and swing check valves available in 18-8 stainless steel and in monel metal. These valves are designed for liquid or gas working pressures of 150 psi and working temperatures up to 350 F.

The swing check valves are available in sizes ½ to 2 in. with screwed or flanged ends and in sizes 2½, 3, 4, and 6 in. with flanged ends only. In the ½ to 2 in. sizes the body is made in a y pattern and the cap is on the same center line as the seat opening. Seating surfaces can be reground without taking the valve body from the line. In the 2½ to 6 in. sizes the body is the straightway type with the seat face at only a slight angle from the vertical. This is said to permit full flow with a minimum of resistance and pressure drop.

On the globe and gate valves, available in 2½, 3, 4, and 6 in. sizes with flanged ends, stem threads are on the outside of the valve so that they cannot be directly exposed to corrosive action. The stuffing box, said to be unusually deep, contains from seven to 10 packing rings, depending on the valve size. The yoke and bonnet assembly is cast in one piece and the bonnet is bolted to the valve body. The disc, says the manufacturer, has an accurately machined, ball shaped seating surface.

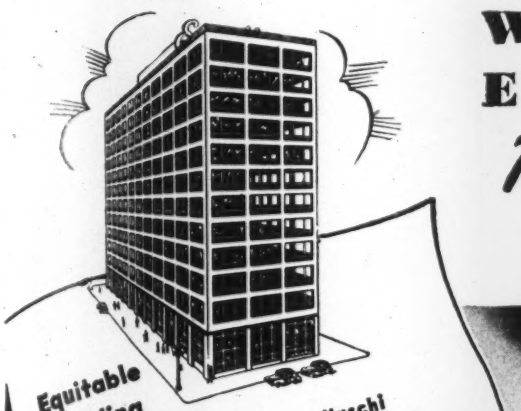
Improves Design of Refrigerant Condenser

No. 3750—Niagara Blower Co., 405 Lexington Ave., New York 17, N. Y., has announced an improved design of its "Aeropass" refrigerant condenser.

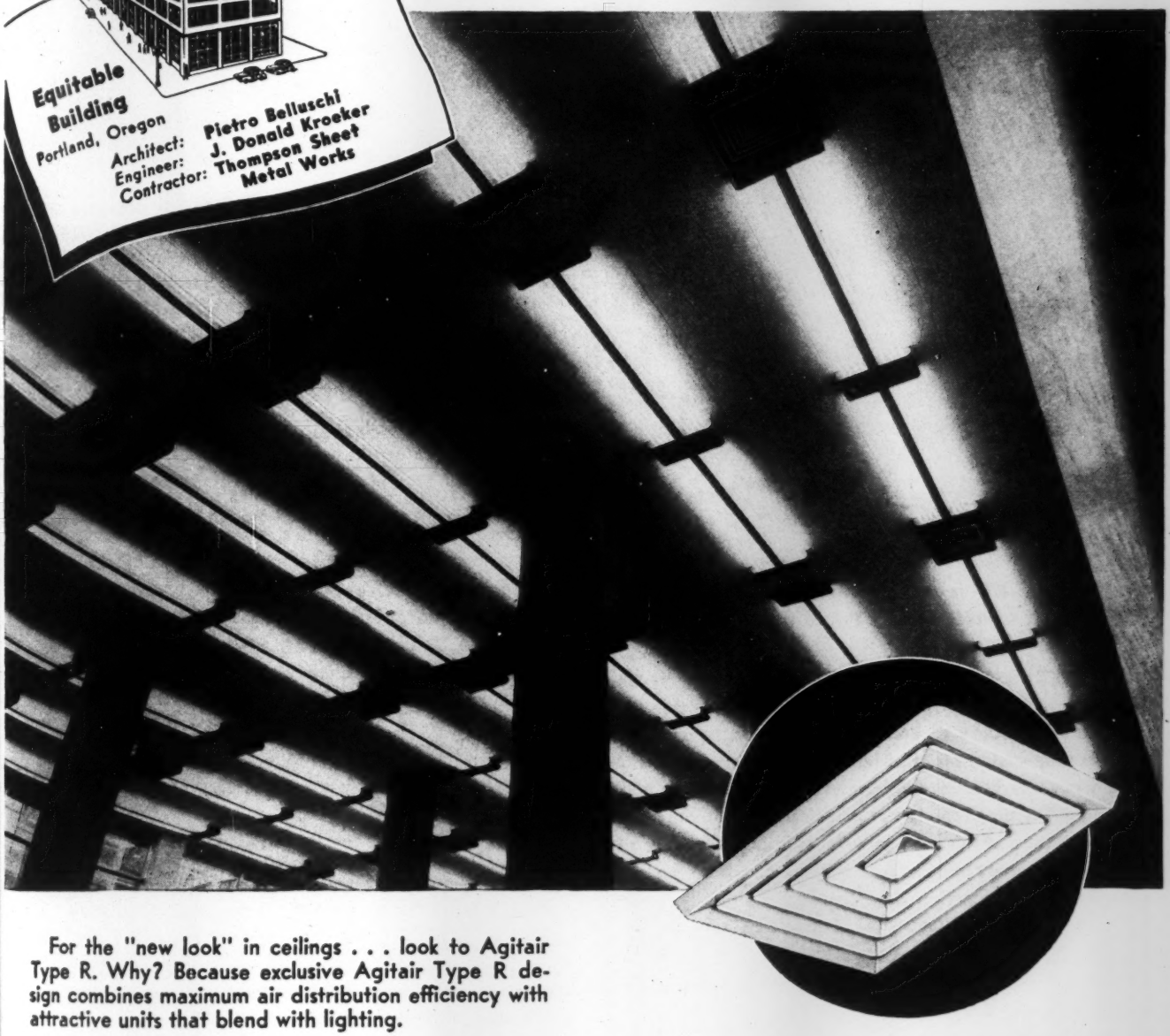
Condensing is accomplished by passing the gas through two coils located in an air stream. The dry "Duo-Pass" coil, together with the "Oil-Out" is designed to take out the superheat and to remove oil vapor from the refrigerant. A water spray is used on the second coil to condense the refrigerant. The water is recirculated and make-up is added to offset that evaporated.

When Specifications Call For Efficient Air Distribution *Plus* Perfect Blending . . .

It's AGITAIR TYPE R



Equitable Building
Portland, Oregon
Architect: Pietro Belluschi
Engineer: J. Donald Kroeker
Contractor: Thompson Sheet Metal Works



For the "new look" in ceilings . . . look to Agitair Type R. Why? Because exclusive Agitair Type R design combines maximum air distribution efficiency with attractive units that blend with lighting.

The Agitair Type R adds more than beauty. It provides correct volume of air with 100% control of air distribution in any shape area, from any location—with no drafts, no blank corners, no hot spots, no cold spots. Patented Construction permits it to be assembled into numerous patterns which divide the air and distribute it noiselessly in one, two, three, or four directions in proportion to the area served. Assembled from standard parts, even the most complicated shapes are economical.

Today, more and more specifications call for efficient air distribution plus perfect blending with planned lighting. Get the facts on Agitair Type R.

Write for Complete Data

AIR DEVICES, Inc. • 17 East 42nd Street • New York 17, N. Y.

CEILING AIR DIFFUSERS AIR FILTERS ROOF EXHAUSTERS

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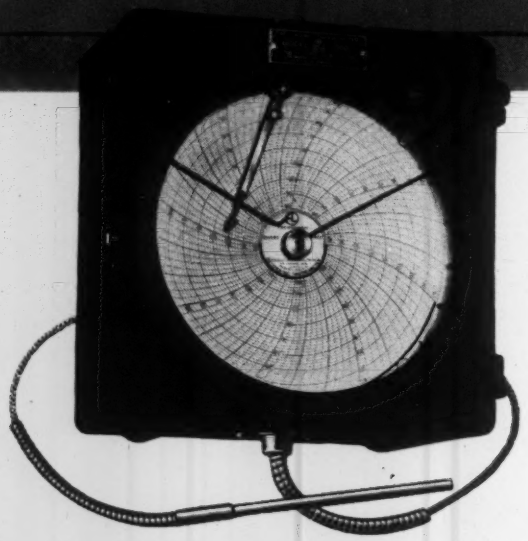
ACCURATE
TEMPERATURE RECORDING

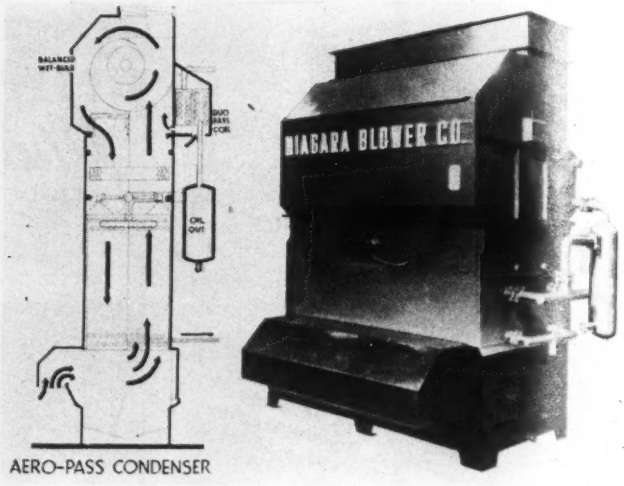


Model "500" is equipped with capillary tubing for remote reading. Priced from $37.50

THIS Auto-Lite Recording Thermometer is designed for utmost efficiency and dependability. Its vigilant recording of continuous operating cycles furnishes money-saving proof of temperature behavior. 6-inch chart with sub-divisions uniformly spaced. Model "500" Recording Thermometer is not affected by altitude or by the temperature of the room in which it is located. All readings represent true temperatures at the point where the bulb is inserted. Write for illustrated catalog describing the Recorder and other styles and types of Auto-Lite thermometers.

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION • TOLEDO 1, OHIO
NEW YORK CHICAGO SARNIA, ONTARIO

AUTO-LITE
INDICATING & RECORDING
THERMOMETERS

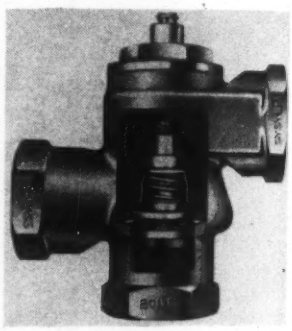


AERO-PASS CONDENSER

The new design affects the head pressure control method. The interior of the casing is partitioned so that dampers are used to admit all outside air or any degree of recirculation. This, says the manufacturer, varies with outside air temperature and the condensing load—so that compressors may be operated automatically at the desired head pressure. In winter, an electric heating element in the spray water tank is used to prevent freezing.

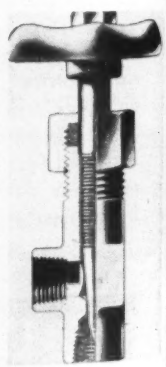
The condenser is available in sizes from 10 to 100 tons.

Thermostatic Valve Controls Water Temperatures for Panel Heating



No. 3751—The "Paneltrol" is a low cost device, offered by Taco Heaters, Inc., 137 South St., Providence 3, R. I., which can be used to control the temperature of water (between 110 and 150 F) delivered to radiant heating panels, provided the boiler water temperature is maintained higher than these settings. It also is used to permit domestic hot water being obtained from the same boiler—inasmuch as the boiler water temperature may be carried at 180 F or higher.

Micrometer Thread Features Needle Valve Design



No. 3752**—A stainless steel stem having 40 threads per inch and a long taper is used in the new precision type needle valve offered by Carpenter Mfg. Corp., 9523 Detroit Ave., Cleveland, Ohio.

The valve body, of solid brass bar stock, is available with pipe threads, straight threads, tube machinings, or unions. The manufacturer guarantees the valve for 500 psi, oil, water, or gas service and states that the adjustment is as delicate as on a micrometer, since the same type of threads are used on the stem.

Million-Dollar Cooling Installation Speeded with Arc Welding

By J. Gordon Turnbull, President
J. Gordon Turnbull, Inc., Cleveland, Ohio

A MILLION-DOLLAR air conditioning installation is now in-progress at the Higbee Company department store, Cleveland, Ohio. It is planned for completion without the loss of a single day's business. Replacing a carbon-dioxide system, the new chilled-water installation has sufficient capacity for air conditioning the entire 12-story building.

Refrigeration capacity of 2800 tons is developed by three 800-ton and one 400-ton centrifugal compressors driven by synchronous motors. Chilled water at 45° F. is pumped from the refrigeration condensers through 12" pipe lines to individual air conditioning units (Fig. 1). Condenser water for the Freon compressors is circulated at a rate of 8400 gallons per minute through 24" pipe between the compressor room in the sub-basement and the cooling tower on the roof.

Space restrictions encountered in erecting the pipe are overcome by the use of arc welded pipe construction. The elbows used are butt welded to pipe of ¼" wall thickness with five passes of 5/32" "Fleetweld 5" electrode, using Lincoln "Shield-Arc" welders (Fig. 2). All pipe joints were tested under 280 pounds per square inch pressure and not a single leak was detected.

Arc welded basement supports for the piping (Fig. 3) rest directly upon the building foundation. The upper floor pipe support platform is made from I-beams arc welded to the main building columns using angle plates. The 100,000-pound load imposed by the 24" pipe is carried through angle thrust plates that are fillet welded to the pipe and bear directly on the upper floor support platform.

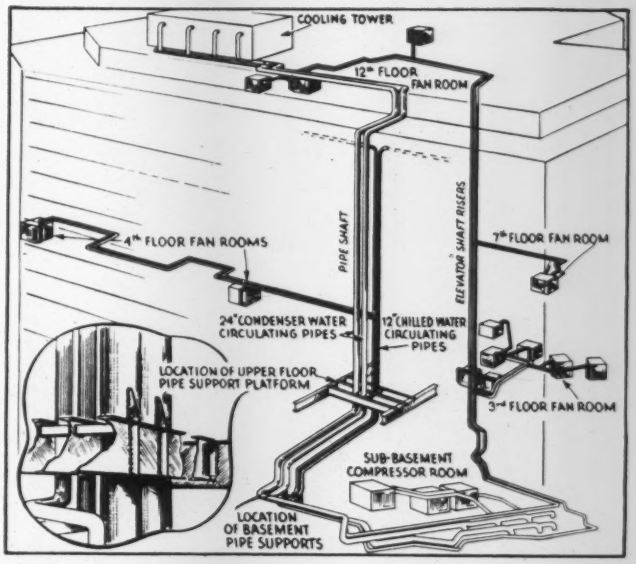

COOLING TOWER
12th FLOOR FAN ROOM
4th FLOOR FAN ROOMS
PIPE SHAFT
ELEVATOR SHAFT RISERS
7th FLOOR FAN ROOM
24" CONDENSER WATER CIRCULATING PIPES
12" CHILLED WATER CIRCULATING PIPES
LOCATION OF UPPER FLOOR PIPE SUPPORT PLATFORM
3rd FLOOR FAN ROOM
SUB-BASEMENT COMPRESSOR ROOM
LOCATION OF BASEMENT PIPE SUPPORTS

Fig. 1. Piping diagram for chilled water and condenser water. Sweeney and Wise, Cleveland, Ohio, piping contractors.

The cooling tower, 100′ long, 30′ high and 25′ wide, weighs 280,000 lbs. It is a redwood, induced-draft spray-type and transite covered. The tower is supported on an I-beam platform welded to the main building framework.

Present plans provide for cooling only the first four floors and twelfth floor. Additional fan rooms or air conditioning units will be added progressively until the entire building is air conditioned. The present installation involves the replacement of 12 old and four new air conditioning units. Each unit includes an air wash, filter and Precipitron.

Fig. 2. Welding 12" pipe with "Fleetweld 5" electrode.

Fig. 3. Basement supports for 12" and 24" pipe.

The above is published by LINCOLN ELECTRIC in the interests of progress. Properties and procedures of "Fleetweld 5" electrode are given in Bul. 403. Write The Lincoln Electric Company, Dept. 271, Cleveland 1, Ohio. **Advertisement**

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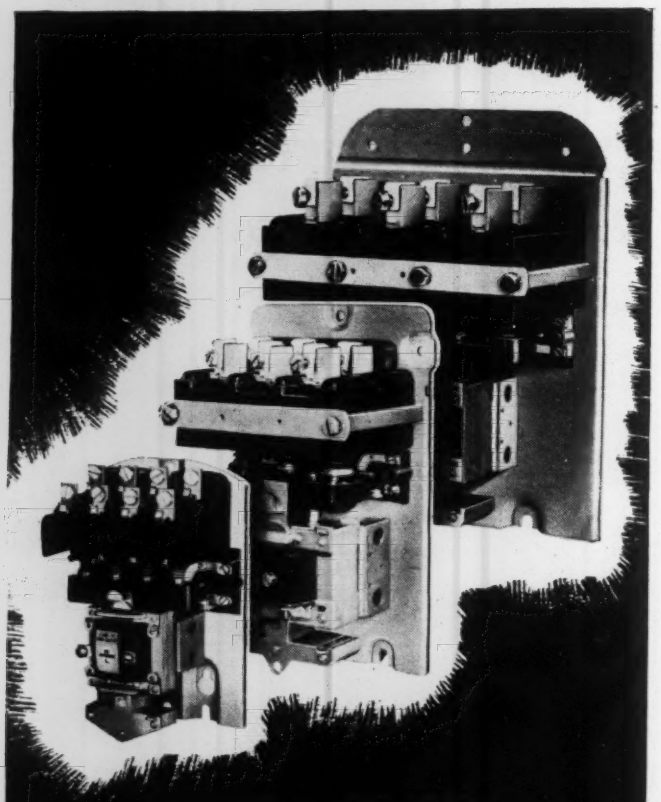

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Sizes 1, 2 and 3 of Ward Leonard's new Solenoid Contactors are now available

The advantages of Ward Leonard's recently introduced A-C Solenoid contactor can now be obtained in 2 and 3 pole combinations rated up to 100 amperes.

All these sizes provide "Result-Engineered" features which you can't afford to overlook. Let us point them out to you . . . Write for our Bulletins 4451, 4452, 4453 and be convinced. Ward Leonard Electric Co., 24 South St., Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

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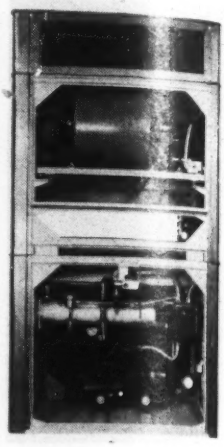
Packaged Air Conditioners Have Sealed Compressors



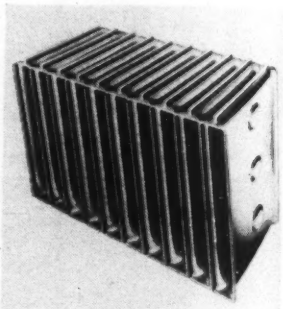
No. 3753—With the announcement of the addition of three new packaged air conditioners featuring sealed compressors, American Thermal Industries, Inc., 440 Illinois Ave., Detroit 1, Mich., is again in full production of its complete line of 3, 5, 7½, 10, and 15 ton packaged units.

Powered by Servel compressor units, the new 3, 5, and 10 ton conditioners are said to incorporate the latest engineering developments and to be outstanding in simplicity, performance, quietness, and economy of operation. Completely equipped at the factory, the machines incorporate an original control system designed to insure reduced pressure starting and the elimination of refrigerant "slugs."

Develops Large Propeller Fan for Quiet Operation

No. 3754—Quiet operation without loss of efficiency is said to characterize the "Lo-Noise" fan developed by Hartzell Propeller Fan Co., Piqua, Ohio. The fan blades are of a wide design and are powered by a totally enclosed motor. The fan is delivered complete with motor, belt, blades, and a curved orifice ring. It is available in sizes ranging from 28 to 48 in. delivering from about 6000 to 30,000 cfm. The company states that the fan is suitable for use where quiet operation is necessary, such as in offices, restaurants, and stores.

Heavy Gage Steel Used in Heat Exchanger

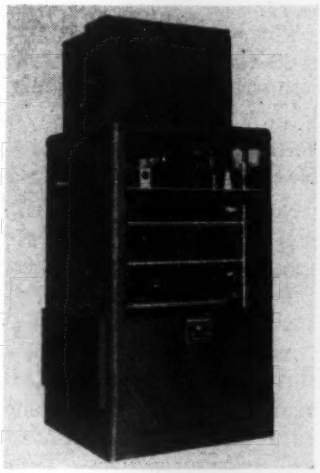


No. 3755—The "Hevigage" steel heat exchanger developed by Bryant Heater Co., 17825 St. Clair Ave., Cleveland 10, Ohio, is now being used in the "Utilaire" unit heater and other products in the company's line of gas fired heating equipment.

Almost three times the minimum requirements of the American Gas Association, 12 gage steel plate is used in the construction of this heat exchanger. Each section is formed into an almost closed U shape which is then permanently closed by electric welding. The interior of the section is said to be a streamlined tunnel for free passage of warmed air. Individual sections are then joined together by outside electric arc welds along the entire front and back edges. The number and size of the sections vary with the capacities of the equipment in which the exchanger is to be installed.

According to the company, the gas flame is directed fully across the bottom of the exchanger where it comes in contact with the full, unbroken thickness of steel. Neither side nor top welds are exposed to flame travel.

Develops Self Contained Precipitator for Many Commercial Applications



No. 3756—Introduced at the 8th International Heating, Ventilating, and Air Conditioning Exposition, a new self contained packaged precipitator, complete with blower, is now available from Raytheon Mfg. Co., Waltham, Mass.

Units are available in two sizes; 1200 to 1500 cfm, and 1800 to 2250 cfm. Each size can be furnished with either a hand operated or automatic solenoid controlled washer. According to the manufacturer, these units are especially suitable for restaurants, shops, offices, bars, grills, and other commercial establishments.

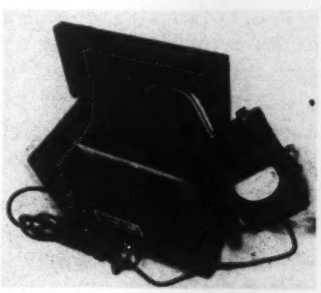
Static Desiccant Dehumidifiers Reduce Moisture in Storage Spaces

No. 3757—"Desican" static desiccant dehumidifiers are designed to reduce relative humidity in sealed storage spaces in order to prevent corrosion, rust, and mildew of various materials or caking and sogginess in foodstuffs. They are available from Dry Air Products Corp., 726 Jackson Pl., N. W., Washington 6, D. C.

The unit is a flat, round aluminum container with a perforated top admitting air to the solid adsorption desiccant. An indicator eye in the center top of the container is used to show if the desiccant is adsorbing or is saturated. According to the company, these dehumidifiers may be used in intimate association with even powdered foodstuffs, such as malted milk, and in association with fine machined parts such as jewelry and adding machines, as their construction prevents any of the drying agent from sifting out of the containers or any powdered material from getting in. In the active state the color of the indicator eye is blue, turning to pink when the desiccant is saturated. Reactivation is obtained by heating to 300 F.

Five sizes are available, the smallest being suitable for use in a space approximately 1 cu ft and the largest designed for use in a sealed space of about 80 cu ft. Among the many uses cited by the company are the protection of enclosed closures, instruments, films, tools, chemicals, leather goods, cameras, foodstuffs, etc.

Improved Meter Measures Wide Range of Air Velocities



No. 3758—An improved air velocity meter has been announced by the Hastings Instrument Co., Inc., P. O. Box 1275, Hampton, Va. It is designed to measure accurately velocities as low as 5 fpm.

The new model incorporates the basic noble metal thermopile principle, a larger, more accurate meter,

CASE REPORT No. 47 from a series of actual cases recording the successful application of BEAR DY-NAMIC BALANCING to Industry.

Carter Motor Co., Chicago, has Bear-Balanced electric motor armatures, rotors, and other rotating parts for five years.

MOTOR CO. FINDS 4 PRODUCTION ADVANTAGES *with* BEAR DY-NAMIC BALANCING

SPEED

Each of the rotating bodies in a Carter Motor assembly is put into perfect Dy-Namic Balance in 2 to 3 minutes. Further, it takes just a few hours to train male or female operators for Bear Balancing Machines. This makes it possible for the Carter Motor Co. to maintain increased production schedules.

BETTER BALANCE

Comparison with balancing-results obtained by other methods, proves that Bear Dy-Namic Balancing attains a higher degree of balance at highly increased RPM's.

VERSATILITY

Many different rotating parts can be Dy-Namically Balanced in a short time, because Bear Balancers are suitable for "quick-change" of set-ups. Many production savings for Carter Motor Co., have originated from this versatility.

IMPROVES PRODUCT

Performance of the finished product has been definitely improved by Dy-Namic Balancing through elimination of vibration and noise. The consequent smooth mechanical operation also helps to prolong the life of Carter Motor products which, in turn, promotes greater customer satisfaction.

INDUSTRY-WIDE ACCLAIM OF BEAR DY-NAMIC BALANCING!

Through resourcefulness and years of Dy-Namic Balancing experience, Bear Balancing has been developed to take on any balancing task. Right now, manufacturers in every line are successfully Bear Balancing all kinds of rotating bodies from tiny armatures to railroad wheels. No doubt our files contain a case report of an operation similar to yours. Write for full details and the latest Bear Industrial Balancing Catalog. Bear Mfg. Co., Dept. H-16, Rock Island, Illinois.

BEAR

COMBINATION STATIC AND *DY-NAMIC BALANCING* MACHINES

2724-R

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MODEL "E" GRILLES and REGISTERS
MODEL "F" GRILLES and REGISTERS
MODEL "M" GRILLES and REGISTERS
VOLOCITROLS Adjustable for Air Flow Control
AIRTURNS for Reducing Friction Losses
...and Sight-lite GRILLES
Send for the UNI-FLO Catalog which gives complete information on the types, features and applications of all UNI-FLO and VENTURI-FLO units. Ask for Bulletin F-1415-7.
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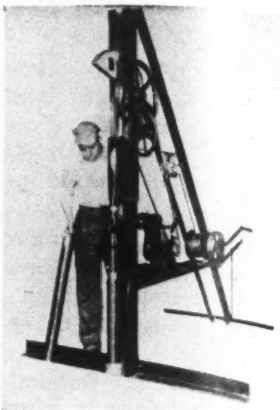
Engineered Air Distribution with Guaranteed Performance
REPRESENTATIVES IN ALL PRINCIPAL CITIES

and also includes an increase in the standard range of the instrument from 2000 to 6000 fpm with no sacrifice in the accuracy of the low velocity measurements.

The lower half of the scale is expanded for reading of velocities from 0 to 200 fpm while the upper half is compressed logarithmically for readings up to 6000 fpm.

Small Well Driller Powered by Electric Motor or Gasoline Engine



No. 3759—The "Consol" well driller is a new development and a new product built by Consolidated Industries, West Cheshire, Conn. It is designed primarily to enable individuals having the time and a basic understanding of mechanics to drill their own wells at a low cost.

The unit has a base 6 x 6 ft and is 8 ft high—thus permitting its use both indoors and outdoors. Shipping weight is approximately 450 lb and the drill point is of special material similar to that used for oil well drilling.

The distance of the drop of the drill is adjustable to meet the ground conditions encountered. The driller is operated at approximately 38 strokes per min and is equipped with an automatic feed-out device which permits the cable to feed out freely as the drill progresses down during the operation. The manufacturer will supply 4 in. casings in 5 ft lengths and regrind drills where desired.

The machine operates on a ½ or ¾ hp electric motor or a small gasoline engine. It is furnished complete with drill, bailer, and 100 ft of cable.

Magnesium Rod Protects Hot Water Tanks From Corrosion

No. 3760—A slender magnesium rod, said to prevent or greatly lessen corrosion of hot water tanks, is made from an alloy developed especially for this purpose by Dow Chemical Co., Midland, Mich.

The rods are used to protect the tanks from the destructive electrolytic reaction set up between water and the metal surface of hot water tanks. According to the company, magnesium's high driving voltage reverses the current flow so that the rod takes the brunt of the corrosion attack rather than the tank. As the magnesium is gradually consumed, it protects the tank wall, preventing pitting, leaks, and eventual tank failure.

The life of the rods in galvanized hot water storage tanks is determined by the rate at which current is withdrawn from the rod or anode, and this, in turn, is primarily a function of the conductivity of the water. According to the manufacturer, less than 5 percent of the anodes will have a life of less than three years.

Improves Ultraviolet Output and Increases Life of Germicidal Lamp

No. 3761—A new bactericidal lamp that is said to emit more than twice as much ultraviolet radiation as lamps

heretofore available has been developed by Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa. It is a 36 in. long, instant start, "Slimline Germicidal Sterilamp" that may be operated at three different levels of ultraviolet intensity. The output varies depending upon the current rating of the ballast used with the lamp.

This more efficient lamp, says the manufacturer, will greatly reduce the overall cost of ultraviolet protection as it not only produces a large amount of ultraviolet for each watt of electricity consumed, but also provides an almost uniform level of radiation throughout its life.

The best electrical features of all of the company's previous ultraviolet lamps have been combined in this lamp, notable of which is the dual electrode designed to operate cold on instant starting and hot for efficient operation. The new glass used for the lamp tube is said to have a remarkable resistance to solarization, an opaquing effect that tends to reduce the amount of ultraviolet radiation. The rated life of the lamp is 6000 hr.

Automatic Acetylene Torch

No. 3762—A redesigned and improved automatic acetylene torch, called a gas gun, has been announced by Century Aircraft Co., 5601 W. Century Blvd., Los Angeles 43, Calif.

The torch has a pistol grip, a trigger operated lighting mechanism, and is used for soldering, brazing, sweating in copper fittings, and lead burning. Other features are said to include light weight, automatic extinguishing of the flame, and the use of new interchangeable combustion tubes, nozzles, and extension tips to give a wide variety of flame sizes and to provide access to work which is difficult to reach. A new gas pressure regulator and gage combination is also available.

The device is designed to operate only with acetylene and is ordinarily used with MC or B type acetylene tanks.

All-Cast Construction Used in Safety Relief Valve

No. 3763 — Kunkle Valve Co., Fort Wayne, Ind., is producing a new steam and hot water boiler safety valve known as Fig. 34.

The valve, in seven sizes from ¾ to 3 in., features all-cast construction with top guided, flat seating disc. The try lever is so arranged that weight loading cannot prevent the valve from opening. Normally set at 10 or 15 psi, it can be set at pressures up to 45 psi. Steam capacities range from 257 to 4168 lb per hr. The unit is designed to meet ASME code, case 1026 specifications.

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A New Approach to Air Distribution . . .

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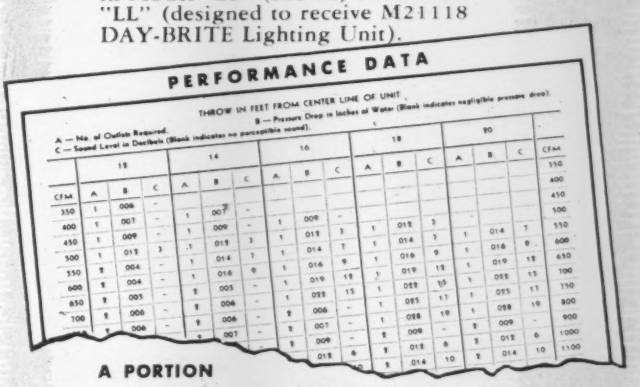
CEILING OUTLETS

A new approach to air distribution — *line-type* outlets that can be used singly or end-to-end in continuous strips. Keyed to modern architectural concepts, they provide a vital contribution to continuity of design. High diffusion efficiency results in rapid induction of room air into the primary stream, quickly equalizing the temperature differential. Made in Model "LS" (shown) and Model "LL" (designed to receive M21118 DAY-BRITE Lighting Unit).



PERFORMANCE DATA

A — No. of Outlets Required.
C — Sound Level in Decibels (Blank indicates no perceptible sound).
THROW IN FEET FROM CENTER LINE OF UNIT
B — Pressure Drop in Inches of Water (Blank indicates negligible pressure drop)

	12			14			16			18			20			
CFM	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	CFM
350	1	.006	-													350
400	1	.007	-	1	.007	-										400
450	1	.009	-	1	.009	-	1	.009	-							450
500	1	.012	3	1	.012	3	1	.012	3	1	.012	3				500
550	1	.004	-	1	.014	7	1	.014	7	1	.014	7	1	.014	7	550
600	1	.004	-	1	.016	9	1	.016	9	1	.016	9	1	.016	9	600
650	1	.005	-	1	.005	-	1	.019	12	1	.019	12	1	.019	12	650
700	1	.006	-	1	.006	-	1	.023	15	1	.023	15	1	.023	15	700
750	1	.006	-	1	.006	-	1	.006	-	1	.025	17	1	.025	17	750
800	1	.006	-	1	.007	-	1	.007	-	1	.028	19	1	.028	19	800
900				1	.009	-	1	.009	-	1	.009	-	1	.009	-	900
1000							1	.012	6	1	.012	6	1	.012	6	1000
1100							1	.014	10	1	.014	10	1	.014	10	1100

A PORTION OF THE DATA FROM WHICH LINE-O-FLO OUTLETS CAN BE ACCURATELY SELECTED

Knowing the CFM available and the THROW required, the number of standard units needed is quickly obtained from performance data tables such as the one shown in part above.

WRITE FOR COMPLETE DATA...

Ask for Bulletin F-2741 and get full performance data, dimensions, description, principles of operation, typical installation methods, and suggested uses. Write today.

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Engineered Air Distribution with Guaranteed Performance

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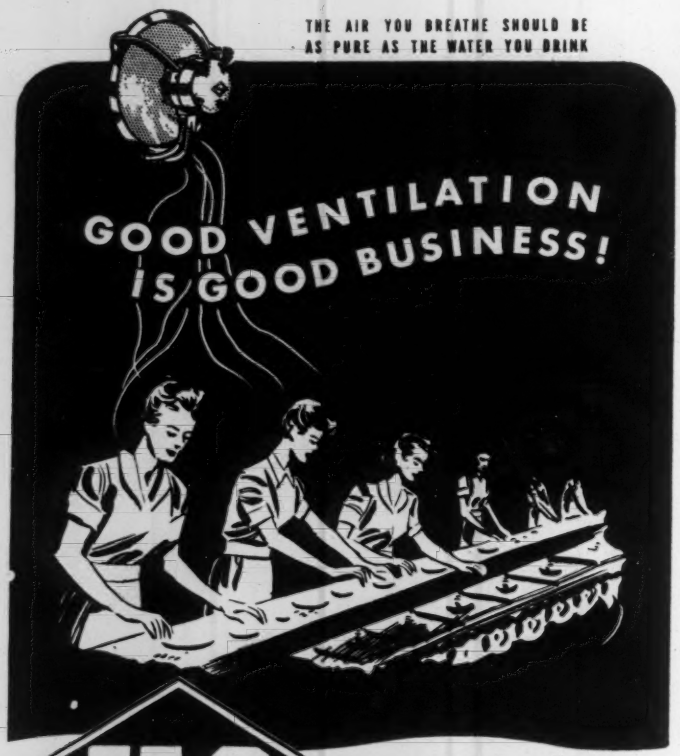
THE AIR YOU BREATHE SHOULD BE AS PURE AS THE WATER YOU DRINK



ILG VENTILATION

Alert operators have learned that it pays well to provide workers with plenty of fresh, cooling air! Records prove that people produce more, are happier when working, have fewer accidents, keep errors at a minimum, and stay on the job longer when they work in a well ventilated atmosphere. Now is the time to make suggestions to management on improved ventilation for the sweltering months to come. If you need assistance, phone our nearby Branch Office (consult classified directory), or send coupon.

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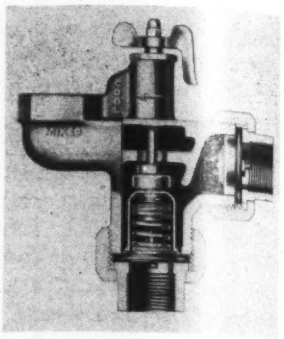
City ..... State .....

Controls Hot Water Temperatures



No. 3764—The type A adjustable tempering valve offered by Taco Heaters, Inc., 137 South St., Providence 3, R. I., is designed to control hot water temperatures at faucets in small buildings.

The valve is adjusted by an external pointer knob to deliver water at temperatures from 120 to 150 F. Of all-brass, bronze, and stainless steel construction, it is available in ½ in. and ¾ in. sizes. The manufacturer states that the thermostatic element is made of a patented material which will not tire, fatigue, or corrode.

Nylon Used in Pressure Gage

No. 3765—The Ashcroft "Duragauge", a product of Manning, Maxwell & Moore, Inc., Bridgeport 2, Conn., is available with a new movement in which duPont nylon is employed. According to the manufacturer, this new movement will outwear and outperform the company's former types, even under the most severe conditions of pulsation and vibration because of the low coefficient of friction, high resistance to shock loading, vibration absorbent characteristics, and corrosion resistant properties of nylon.

Small Steam Trap Handles Air and Condensate

No. 3766—A new "Cub-Jr." steam trap, small in size but having a comparatively large capacity, has been announced by Wright-Austin Co., 315 W. Woodbridge St., Detroit 26, Mich. It is designed for unit trapping installations draining steam heated equipment in laundry, food processing, and similar types of plants.

It is claimed that the use of this new trap results in more satisfactory operation of such steam heated equipment because it discharges air as well as condensate. Because of its light weight, it can be suspended in a horizontal run of pipe without other support. Having two inlet connections at right angles to each other, the trap also may be utilized as an elbow in the line. Screwed inlet and outlet connections are furnished in two sizes: ½ and ¾ in. IPS.

It is stated that the trap will handle up to 2000 lb per hr of condensate on continuous discharge. At 60 psi the rating is 960 lb per hr.

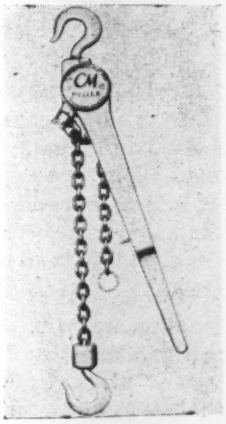
A blowoff connection is provided for removal of particles too large to be expelled through the condensate orifice. Valves are accessible through an outside connection and may be changed for various pressures without other adjustments. The maximum pressure for which the unit is recommended by the manufacturer is 125 psi.

Automatically Vents Radiators, Convectors

No. 3767—The No. 16 hot water air valve, offered by Dole Valve Co., 1933 Carroll Ave., Chicago 12, Ill., is said to be the first low cost device for eliminating air automatically from hot water radiators and convectors.

Three adjustments may be made by the use of a coin or screw driver to provide manual shutoff, automatic air elimination, or manual venting. The valve is made in ⅛ in. IPT size.

Lifts and Pulls From Any Angle



No. 3768—A new, improved model of the CM puller has been announced by Chisholm-Moore Hoist Corp., Tonawanda, N. Y. It is said to be lighter and sturdier than its predecessor and to have a more streamlined appearance.

It is designed to lift or pull at any angle and has been simplified so that fewer parts are used and a number of improvements have been made in the lifting mechanism and method of operation.

Weight reduction has been accomplished through the use of aluminum alloy castings for the housing, cover, and handle. The lift wheel and ratchet are of high carbon steel machined and heat-treated. The number of teeth in the brake and lever ratchets has been increased to permit more accurate spotting of loads. The "Up" and "Down" button has been replaced by a trigger on the handle to permit more convenient one hand operation, and a ring has been attached to the free end of the chain to prevent its being unintentionally pulled through the lift wheel.

Other features include the use of oil impregnated, porous bronze bushings together with gears which are sealed in a grease tight enclosure. Pullers are available in ¾, 1½, 3, and 6 ton capacities.

Equipment Shorts

The "Thermopane" unit offered by Libbey-Owens-Ford Glass Co., Toledo, consists of two or more panes of glass separated by a dehydrated air space which is sealed by a metal-to-glass bond. It was originally developed for heat insulation purposes; however, a recent company announcement indicates that it is proving to be effective for sound insulation in factory buildings and offices where outside noise is a problem. Dr. P. N. Geiger, University of Michigan, has estimated that a 44 percent reduction in noise transmission is possible by using two sheets of ¼ in. glass with a ½ in. air space as compared to a single pane of ¼ in. glass.

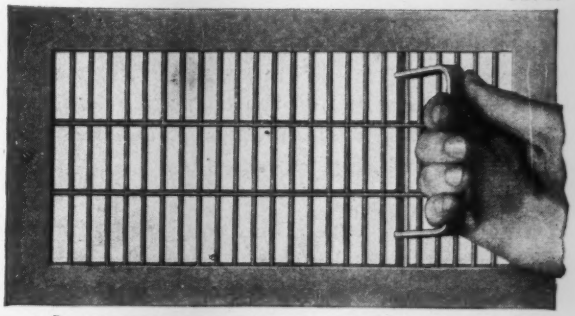
A branch office serving Wichita, Kans., and surrounding territory has been opened by the Minneapolis-Honeywell Regulator Co. Manager for the new branch, located at 1514 E. Central, Wichita, is Lynn H. Johnson, Jr., who has been sales manager of the company's gas controls division until his latest promotion.

INDEPENDENT

"Fabrikated" WALL GRILLES for Commercial Installations

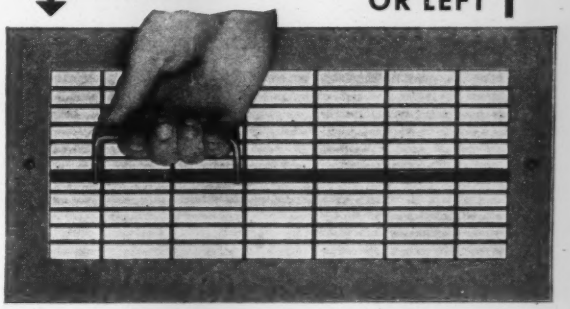
PROVIDE ADJUSTABLE DIRECTED AIR FLOW

321-A



UP OR DOWN

RIGHT OR LEFT



311-A

Made to fit openings in even inches from 8" x 4" to 60" x 40"

Independent Fabrikated* Adjustable Grilles (patented), rigidly constructed with stamped steel rims and steel bars, are made with either vertical or horizontal grille bars. Grille bars are *adjustable* before or after installation; available also with bars permanently set for straight flow.

Write for new Catalog No. 48—gives schedule of sizes, details and prices.

Always Leading — Always Progressing

*Reg. U. S. Pat. Off.

THE INDEPENDENT REGISTER CO.

3747 E. 93rd STREET · CLEVELAND, OHIO

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Equipment Shorts (Cont.)

The formation of an industrial and utility section of Borg-Warner International Corp. has recently been announced. The new division, with headquarters at 321 W. Lafayette Ave., Detroit, will be headed by Claude Pitts, formerly general product manager of the appliance section. Some of the manufacturers whose export activities are to be handled by the new section include Ingersoll Steel Division, Morse Chain Co., Marbon Corp., and Autopulse Corp.

Pan-L-Heat Corp., 2838 N.E. Columbia Blvd., Portland, Ore., has opened a new testing laboratory which will be used to obtain data on radiant heating equipment. Tests are now under way to determine the effectiveness of heating relatively large areas at a low temperature as compared to smaller areas at a higher temperature. Tests are also being made on the company's hot water grids, radiant warm air units, and other products. According to the company, the laboratory facilities will be made available to manufacturers and designers of heating and ventilating equipment.

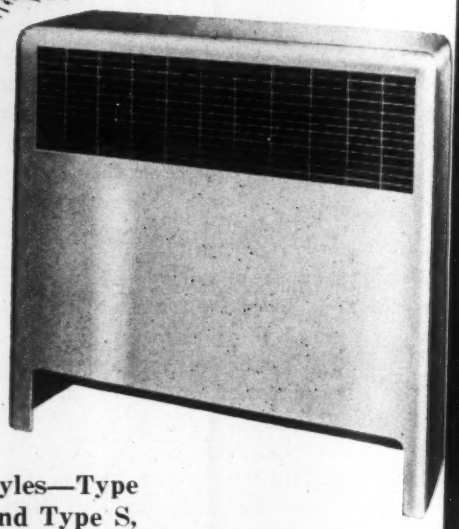
Student capacity, space, and equipment facilities at the instrumentation school of Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., Philadelphia, has been doubled through the leasing of new and larger quarters consisting of a four story building. The school, now in its 14th year, is used in training both customer and company service and maintenance engineers.

According to the welding division, Harnischfeger Corp., Milwaukee, the brazing time on cooling coils has been materially reduced by McQuay, Inc., Minneapolis manufacturer of air conditioning and commercial refrigeration equipment, through the use of a welding positioner developed by the Milwaukee firm. The welding operator stands on a self leveling table located on the top of the unit. This is said to enable him to braze all points without having to change his position. A push button control is provided for all operations of the positioner, including power elevation of the table so that it is possible to position the operator as well as the work.

Pannier Bros. Stamp Co., 502 Pannier Bldg., Pittsburgh 12, Pa., has developed a "Master Marker" universal marking machine designed to mark up to four sides of seamless and light wall aluminum, copper, and brass tubing, as well as bars in round, square, hexagonal, and other shapes—in sizes from 3/8 to 2 in. Equipped with a 1/3 hp motor, it is said to be suitable for production or job work.

Schnacke, Inc., Evansville, Ind., manufacturer of refrigeration and air conditioning equipment, is protecting its customers on price quotations to the extent that any future price change will be made only with a 60 day advance notice. This is said to be in line with the company's policy in absorbing all possible increased costs.

Clean, Safe, Economical HEATING with AIRTHERM CONVECTORS



AIRTHERM CONVECTORS for hot water and steam heating systems provide the desirable combination of convection and radiant heating. The attractive cabinets can be readily finished after installation in any color to harmonize with interior decorations.

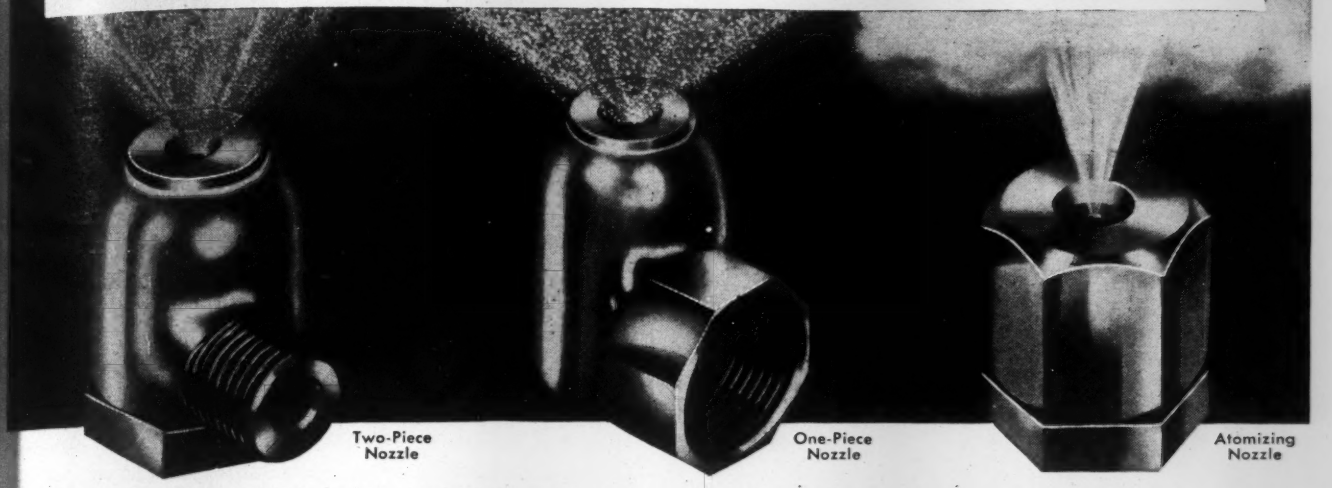
AIRTHERM CONVECTORS are available in three cabinet styles—Type F, free standing or partially recessed; Type W, wall cabinet; and Type S, sloping top wall cabinet—in a complete range of depths, heights, and lengths.

Have you recently investigated the advantages of specifying and installing convectors? Write for new bulletin describing AIRTHERM CONVECTORS.

AIRTHERM MANUFACTURING CO.

711 South Spring Ave. • St. Louis, Mo.

Greatest Distribution at Lowest Pressure



Two-Piece Nozzle | One-Piece Nozzle | Atomizing Nozzle

MARLEY PATENTED SPRAY NOZZLES deliver the ultimate in nozzle performance: *"Greatest distribution at lowest pressure."* The exclusive Marley design accomplishes top results with no moving parts. Offset venturi-type intake opening produces spiral action in the whirl chamber that results in a perfect cone of spray.

MARLEY NOZZLES are non-clogging in normal service. If clogging conditions exist, the **MARLEY TWO-PIECE NOZZLE** may be easily cleaned without removal from the line.

MARLEY ATOMIZING NOZZLES produce a mist-like spray with no large globules of liquid. It has achieved wide acceptance in process industries, for air washing, fruit and vegetable hydration, product mixing, DDT spraying.

Makers of the Complete Line of Marley Cooling Towers

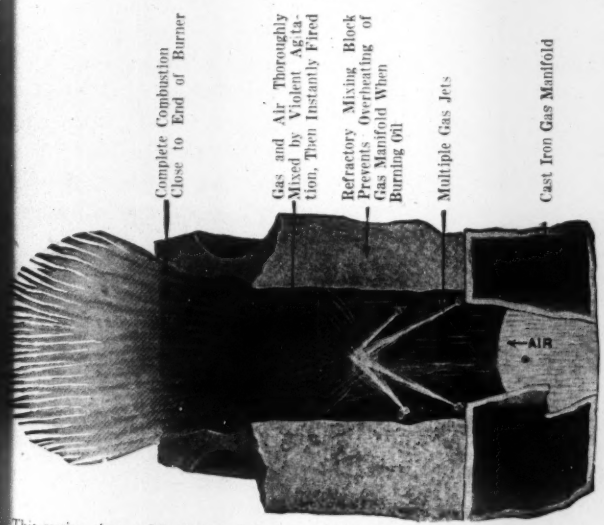
The Marley Way Is the Perfect Spray

Ask for Marley Nozzle Bulletins

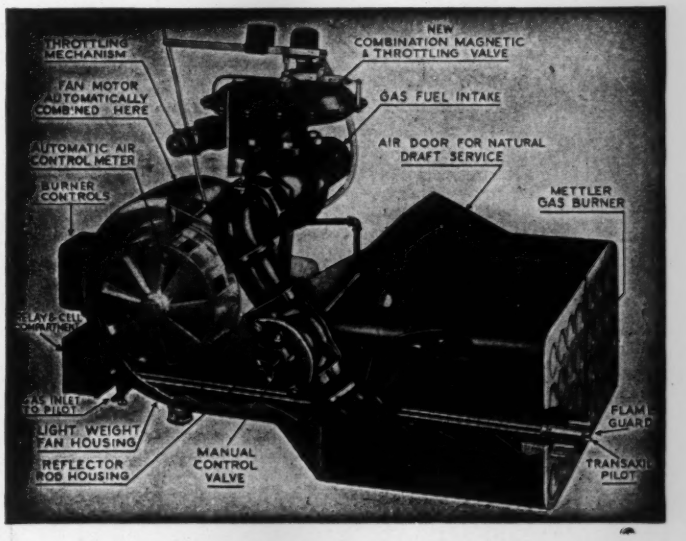
MARLEY COOLING TOWERS

THE MARLEY COMPANY, INC. • KANSAS CITY 15, KANSAS

The Mettler ENTRAINED COMBUSTION Gas Burners


Complete Combustion Close to End of Burner
Gas and Air Thoroughly Mixed by Violent Agitation, Then Instantly Fired
Refractory Mixing Block Prevents Overheating of Gas Manifold When Burning Oil
Multiple Gas Jets
Cast Iron Gas Manifold
AIR

This section thru a Mettler Gas Burner Manifold shows how it "mixes" gas and air. It's *easy* to see why it's still the best.



The "Fan-Air Gas Burner" in adjoining picture embodies this leading patented casting design with all the other essential and desirable features of this *Fully Assembled Mechanical Draft Automatic Gas Burner.* It comes to you complete as pictured, representing the modern day burner. Why be satisfied with less—when all these tangible advantages are so readily available in sizes 5 to 400 HP.?

SIZES 5 TO 400 HP.

LEE B. METTLER CO.

406 South Main Street

PROMPT SHIPMENTS

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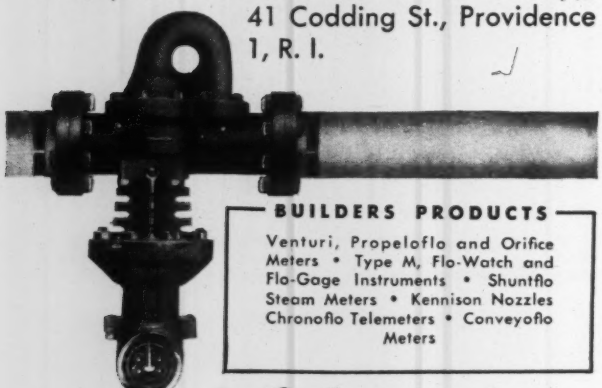
Another Good Reason Why You Should Select THIS Steam Meter

- NO MAINTENANCE
- NO DRIPPING
- NO BINDING
- NO PACKINGS

The magnetic drive of Builders Shuntflo Steam Meter banishes stuffing box difficulties. For Bulletin 349, address Builders-Providence, Inc., (Division of Builders Iron Foundry), 41 Codding St., Providence 1, R. I.



BUILDERS PRODUCTS

Venturi, Propeloflo and Orifice Meters • Type M, Flo-Watch and Flo-Gage Instruments • Shuntflo Steam Meters • Kennison Nozzles Chronoflo Telemeters • Conveyoflo Meters

BUILDERS PROVIDENCE Instruments

EXECUTIVE CHANGES

The appointment of E. L. Bedard as sales manager for Mt. Hawley Mfg. Co., Peoria, Ill., was recently announced. He will handle the sales of the company's oil burners and boiler-burner units.

C. H. Schuettenberg has been named sales manager of Holcomb & Hoke Mfg. Co., Inc., Indianapolis. He has been active in the Stoker Manufacturers' Association, as well as in numerous stoker, coal, and sales organizations.

H. E. Sill, vice president, Muncie Gear Works, Inc., Muncie, Ind., has been elected secretary-treasurer of the Stoker Manufacturers' Association. He succeeds F. H. Herndon of the Link-Belt Co., Chicago, who resigned this position because of his company's disposal of its stoker division to the Timken-Detroit Axle Co. C. P. Meredith, vice president, Steel Products Engineering Co., Springfield, Ohio, has been appointed a member of the association's board of directors to fill the vacancy created by Mr. Herndon's resignation.

Henry Valve Co., Chicago, has appointed G. W. Wheeler as field engineer in the Ohio territory. He has been export manager for the firm.

The new district manager for Penn Electric Switch Co.'s Goshen, Ind. territory is H. C. Shilling. He joined the company about seven years ago.

Fedders-Quigan Corp., Buffalo, N. Y. has named J. W. Fenyvest as export manager. According to the company, he has traveled extensively throughout the world and has wide experience in export marketing.

G. E. Mills, of Cleveland, has been appointed public relations director of the Refrigeration Equipment Manufacturers' Association. In his new position he will combine publicity and promotional activities for REMA with a public relations program designed to result in a more closely knit relationship among the various segments of the industry. Public relations offices of the association have been established at 3751 Prospect Ave., Cleveland.

Bryant Heater Co., Cleveland, has appointed P. B. Borthwick as personnel director. He is a member of the Industrial Relations Association and the Cleveland Chamber of Commerce.

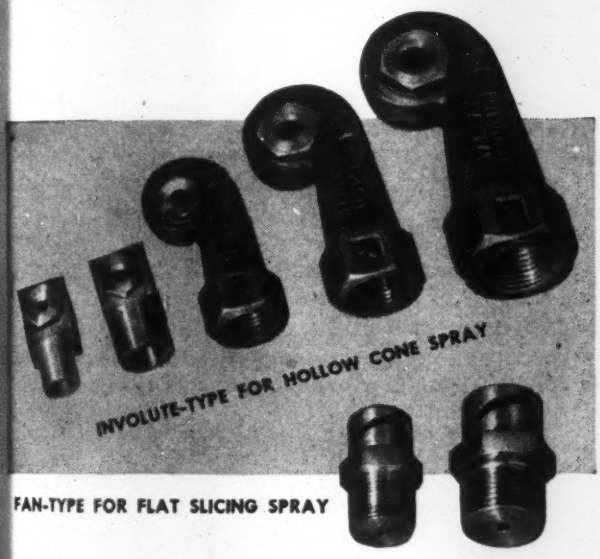
S. E. Deutsch is the new president of Saunders Mfg. Co., Yonkers, N. Y., successor to the century old D. Saunders' Sons, Inc., manufacturer of pipe threading and cutting machinery and tools.

C. S. Conrad, Jr., has been appointed chief architect of the Armstrong Cork Co., Lancaster, Pa. For the past five years he has been assistant chief architect and will now fill the vacancy created by the retirement of Henry Boettcher after 40 years of service with the company. The position of assistant chief architect will be occupied by F. S. Kline who joined the company in 1943.

for • SPRAYING
• WASHING
• RINSING
• COOLING
• AIR CONDITIONING

YARWAY

SPRAY NOZZLES



FAN-TYPE FOR FLAT SLICING SPRAY

Get the most out of your Spraying Equipment with minimum power . . . with efficient spraying.

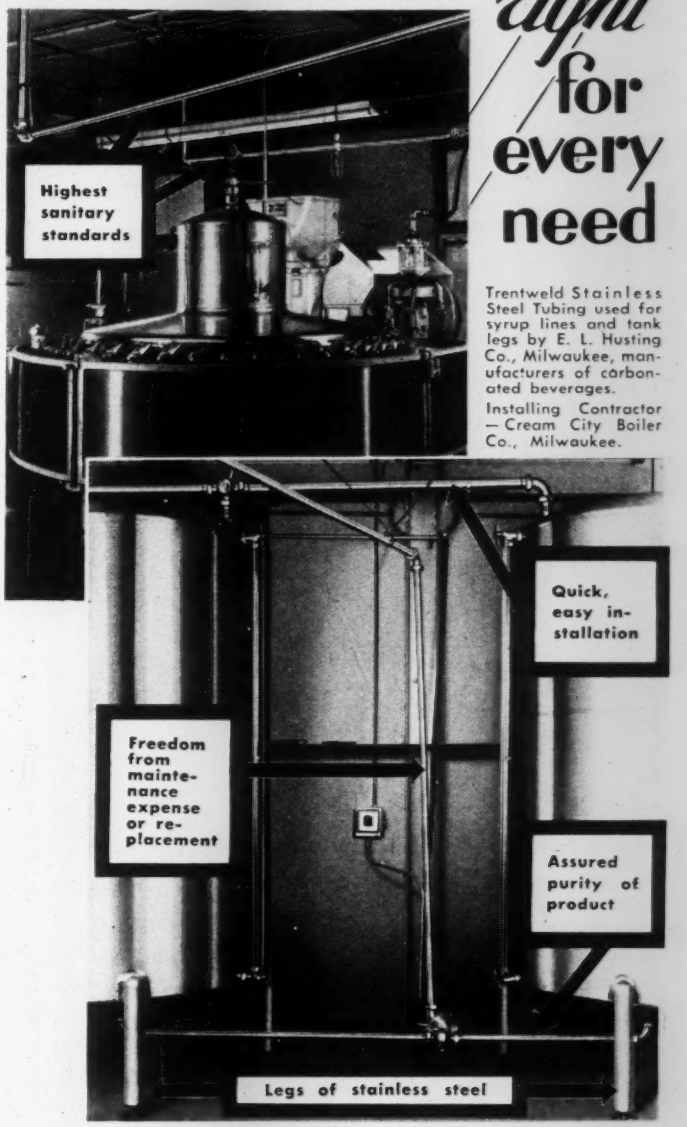
Use Yarway Nozzles. No internal vanes or other restrictions to clog or hinder flow. Two types—Yarway Involute-type producing a fine hollow spray with minimum energy loss, and Yarway Fan-type producing a flat fan-shaped spray with time-saving slicing action for cleaning.

Wide range of standard sizes and capacities. Cast or machined from solid bar stock.

Thousands in use. Write for new Bulletin N-616.

YARNALL-WARING COMPANY
107 Mermaid Avenue Philadelphia 18, Pa.

Flow lines of Trentweld STAINLESS STEEL right for every need


Highest sanitary standards
Quick, easy installation
Freedom from maintenance expense or replacement
Assured purity of product
Legs of stainless steel

Trentweld Stainless Steel Tubing used for syrup lines and tank legs by E. L. Husting Co., Milwaukee, manufacturers of carbonated beverages.
Installing Contractor — Cream City Boiler Co., Milwaukee.

WHEREVER flow lines must carry corrosive substances in any form, the efficiency of Trentweld stainless steel tubing is all inclusive. Highly resistant to the action of acids or alkalines, this rugged thin-walled tubing is made to deliver substantial savings over the years to the installation owners in eliminating replacement costs and maintenance expense. Of interest, too, initially, is the fact that this light weight tubing, in diameters up to 30", is easy to handle under any condition. It saves manpower, makes installation work a smooth-running, time-saving job. Trent engineers are at your call at all times to give you whatever help or information you may require. Without obligation, write:

TRENTWELD STAINLESS STEEL TUBES

District Offices—New York, Chicago

TRENT TUBE MFG. CO.
430 Church St. East Troy, Wisconsin

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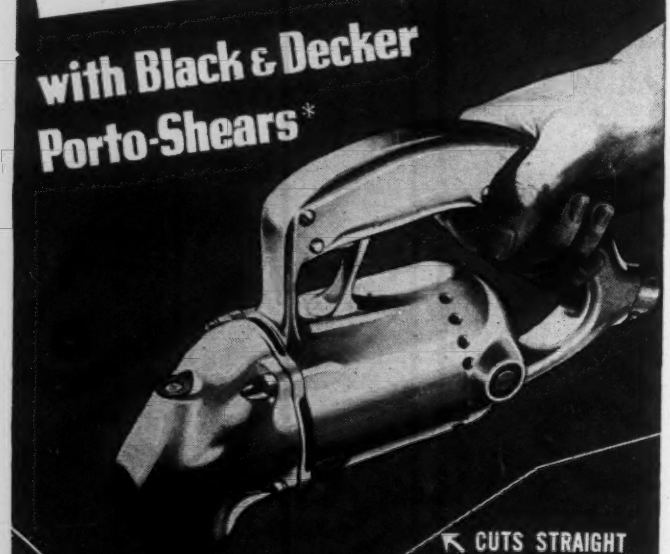
Z-Z-ZIP through Sheet Metal Work

with Black & Decker Porto-Shears*



Black & Decker Electric Porto-Shears cut sheet metal too tough for snips, speed up jobs where snips are slow. Fast, powerful shearing action eliminates hard muscular strain. Easy to follow patterns because cutting operation is always visible. B & D 16-Gage Porto-Shears cut up to rated capacity in steel or galvanized iron; about one gage thinner in Monel or stainless; 50% above rating in copper, aluminum, lead and other non-ferrous metals.

For full information on cost-cutting Porto-Shears . . . and other Electric Tools for heating, piping and air conditioning work . . . see your nearby Black & Decker Distributor. For your free copy of our complete catalog, write to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Maryland.

*Trade Mark Reg. U. S. Pat. Off.

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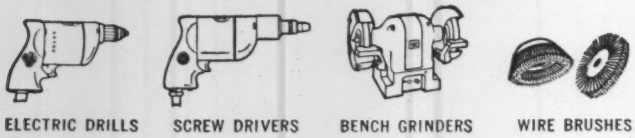
Black & Decker

PORTABLE ELECTRIC TOOLS



ELECTRIC DRILLS SCREW DRIVERS BENCH GRINDERS WIRE BRUSHES

Executive Changes (Cont.)

The appointment of Lee Stratton as merchandise director of the parts division, Reynolds Metals Co., has been announced. In his new position, Mr. Stratton will be in charge of merchandising all products of the division, including building products, housewares, marine products, and refrigeration equipment.

Perfex Corp., Milwaukee, has appointed A. A. Putt as eastern sales representative for the controls division and A. B. Meeg as manager of the industrial controls division. In his new capacity, Mr. Putt will operate from the company's New York office as a special sales representative. Mr. Meeg, a mechanical engineering graduate of the University of North Dakota, was formerly manager of the company's Milwaukee branch office. He succeeds M. W. Crew who resigned to enter his own business.

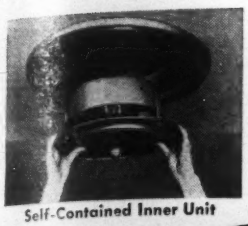
Norman Weinstein is now associated with Calumet Iron & Supply Co., East Chicago, Ind., as vice president in charge of the engineering division. For the past 16 years he has been active in the application, design, and installation of specialized process equipment for the conditioning of air and gases in many industries. His new duties will be directed toward broadening the use of air conditioning equipment for industrial applications.

J. M. Fink, identified for many years with the air conditioning industry, has formed a new company under the name of J. M. Fink Co., Inc., with offices at 125 E. 23rd St., New York City. The new organization will specialize in the design and installation of industrial and commercial air conditioning, heating, ventilation, and refrigeration systems. Associated with him as treasurer is David Bandler, a member of the New York Stock Exchange.

Fedders-Quigan Corp., Buffalo, N.Y., has named W. L. Ledbetter as regional manager of its unit air conditioner division. With headquarters in Dallas, he will be active in the sales of the company's ½ and ¾ ton room air conditioners.

Battelle Memorial Institute, Columbus, Ohio, has named C. E. Miller to act as a technical advisor on research in coal, gas, and petroleum technology. Mr. Miller, who is well known in the utilities and power fields, served during the war as chief of the heating section and assistant chief of the utilities branch of the War Department's office of the chief of engineers. He is currently serving as secretary of the executive committee of the fuels division, American Society of Mechanical Engineers.

Dr. J. A. Hutcheson has been appointed director of the Westinghouse Electric Corp. research laboratories, succeeding Dr. L. W. Chubb who recently rounded out 40 years of research and engineering with the company and is retiring from the active direction of the laboratories for reasons of health. Dr. Chubb has been named director emeritus and will serve in an advisory capacity. Dr. Hutcheson assumes his new post after four years as associate director.

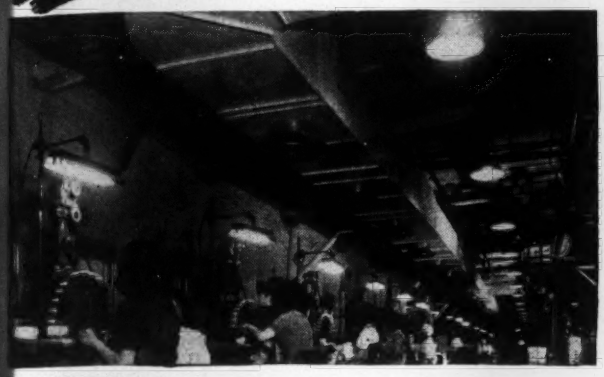


Self-Contained Inner Unit

Air Volume Adjustment

FAST INSTALLATION

"Custom-made" air pattern with Kno-Draft Adjustable Diffusers in Champion Spark Plug Plant



PROBLEM: A ceramic kiln radiates heat on one side and a cold window-filled wall creates drafts on the other. The space is long and narrow with low head room. The occupants work in short sleeves. Unusually large volumes of supply air have to be brought in to combat the heat of the kiln. Space for duct work above the room is limited so that diffusers have to be spaced much closer than usual. The supply air stream has to be directed slightly above the horizontal and evenly distributed so that no drafts are felt by the personnel.

SOLUTION: Kno-Draft Adjustable Air Diffusers were chosen because of their ability to control air direction, volume and throw. A "custom-made" air pattern was created which thoroughly mixed room and supply air, maintained uniform temperature throughout and eliminated drafts, hot spots, and cold spots. *Installation* was fast. Kno-Draft self-contained inner units cut installation time up to 50%. *Balancing* was fast. CFM readings were taken directly with Velometer. A twist of the wrist changes air volume on each diffuser.

Free — New handbook on Air Diffusion

It contains the latest engineering data on air diffusion and is profusely illustrated with charts, photographs, sketches and dimension prints that simplify the selection, application, location, assembly, erection, testing and adjusting of Kno-Draft Adjustable Air Diffusers. It is designed to help you get top efficiency from an air conditioning system by creating "custom-made" air distribution patterns.

For your FREE copy, plea e write Dept. D-11

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Air Diffusion • Air Purification • Air Recovery

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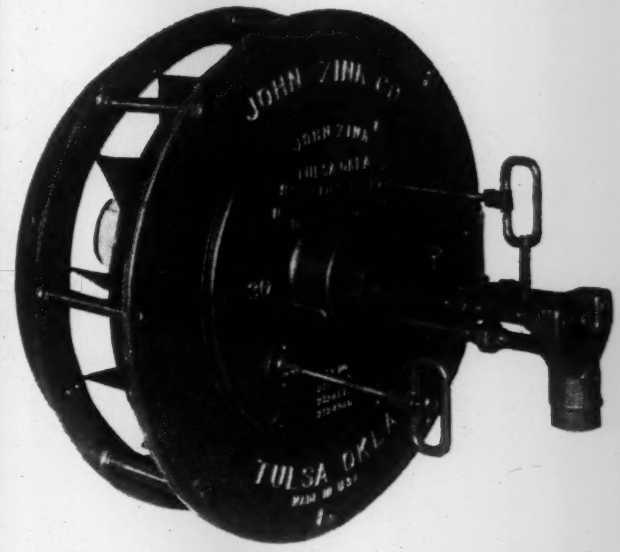
JOHN ZINK BURNERS For INDUSTRIAL and COMMERCIAL BOILERS

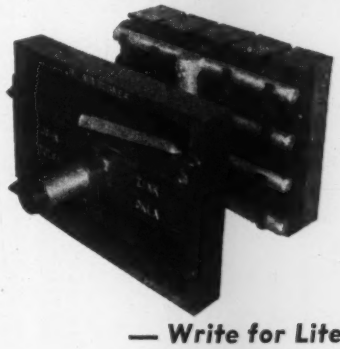


Series "Y" Register Type

Fuel scarcity is no problem if you use John Zink Series "Y" Burners because this burner burns either, or both, gas and oil with the same heat pattern.

- **Independently removable fuel guns.**
- **Uninterrupted Burner service.**
- **Easy to remove fuel guns—Feather weight type, one man can remove for inspection and cleaning while the boiler remains in service.**
- **Easy to operate.**
- **Simple in construction.**

Series "R" Bi-Air Burner



For all types and sizes HEATING BOILERS and small Power Boilers—JOHN ZINK offers the Series "R" Bi-Air short flame, Gas Burner with Multi-jet burners, having refractory semi-venturi mixing throats, with a separate gas orifice to each throat. Capacities to meet your requirements.

Especially adapted for installing in boilers having very low draft and small combustion space.

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John Zink Company

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TULSA, OKLAHOMA

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...makes better valves!

Confidence in K & M steam plant equipment is founded partly on K & M experience that dates back 68 years. And partly on the many K & M "firsts" of yesterday. But the chief reason for the acceptance of K & M products today is the K & M approach — the policy of *continued* pioneering that has *kept* K & M "first for dependability" for so many years.

- PRESSURE REDUCING VALVES
- BACK PRESSURE VALVES
- STRAINERS
- ATMOSPHERIC RELIEF VALVES
- STOP AND CHECK VALVES
- STEAM SEPARATORS
- GREASE EXTRACTORS

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Executive Changes (Cont.)

Baker Ice Machine Co., Inc., South Windham, Me., has appointed A. F. Prior as comptroller. He has been a member of the National Association of Cost Accountants for many years and is the author of a number of articles on plant accounting and budgets.

Leon Norfleet has been named industry manager of the marine division, Reynolds Metals Co., Louisville. He has been with the organization since 1941, except for two years spent in the Navy, and has been assistant purchasing agent and purchasing agent in a number of the firm's plants.

Fairbanks, Morse & Co., Chicago, has appointed W. H. Holbert manager of the Three Rivers, Mich., plant succeeding K. E. Barrett who resigned because of ill health. Mr. Holbert has been manager of the company's Stuttgart, Ark., works for the past 20 years and will be succeeded by J. R. Walsh who, for several years, has been assistant manager of the company's Westco works in St. Louis.

R. T. "Shep" Doherty has joined the general division of York-Shipley, Inc. as supervisor of sales to manufacturers and national accounts. He entered the heating industry in 1928 and has been prominent as a sales engineer and sales executive.

T. B. Hasler, formerly president of Wilson Welder & Metals Co., Inc., a wholly owned subsidiary of Air Reduction Co., Inc., was elected chairman of the board of directors succeeding C. E. Adams who has resigned as chairman and director. F. B. Adams, Jr., has been elected president and a director.

The recently appointed sales director for the central states area of Typhoon Air Conditioning Co., Inc., Brooklyn, is Martin Janasik who will make his headquarters in Detroit and will supervise the company's representation in Michigan, Ohio, Indiana, Kentucky and western Pennsylvania.

The appointment of R. C. Myers as manager of the market development division, Carnegie-Illinois Steel Corp., has been announced. He succeeds R. J. Ritchey, recently appointed director of the new market development division, United States Steel Corp. of Delaware. Mr. Myers joined Carnegie-Illinois in 1939 as a development engineer in sales promotion.

D. D. Spoor is now sales promotion manager of Air Reduction Sales Co., New York City. His new duties include the supervision of a sales training program and the establishment of sales promotion programs for the various company's sales districts throughout the country. R. S. Schmidt has succeeded Mr. Spoor as dealer sales manager.

Whiteley Bearing Corp., 1283 S. Ashland Ave., Chicago, has recently been organized to manufacture graphited bearings, to do oil grooving and special machining, and to make pillow blocks.

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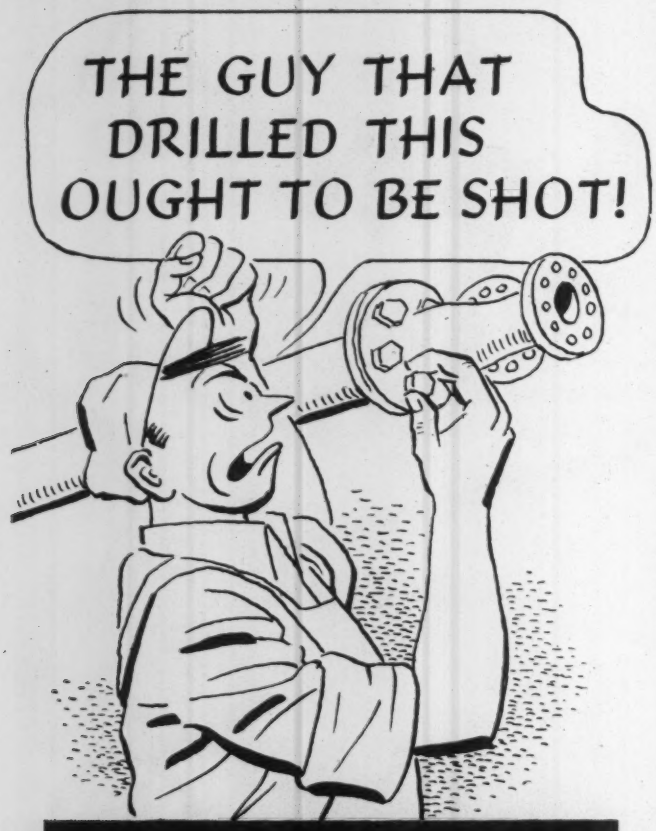

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NEW BOOKS & REPORTS

Compiles Data on Properties of Many Hydrocarbons

Accurate, selected values of the fundamental physical constants and properties of a large number of hydrocarbons have recently been compiled and published by the National Bureau of Standards as Circular C461. This 496 page bound volume, Selected Values of Properties of Hydrocarbons, is a complete collection of all numerical tables issued by the American Petroleum Institute Research Project 44 as of May 31, 1947.

In addition to fundamental constants, conversion factors, useful equations, and molecular weights, the tables include data on the boiling point, pressure coefficient of the boiling point, freezing point, specific gravity, refractive index, molecular volume, molecular and specific refraction, specific dispersion, refractivity intercept, viscosity, vapor pressures, equilibrium constant of formation, thermodynamic properties, cryoscopic constants, and heat of fusion.

The circular may be obtained only from the Superintendent of Documents, Washington 25, D. C., at a cost of $2.75 per copy.

How Overfire Jets Reduce Coal Smoke

"Modern overfire jets strike at the heart of the smoke problem. They provide the turbulence and oxygen to burn the volatile matter from the coal before smoke can be formed", according to a 16 page booklet, Overfire Jets in Action for Smoke Abatement, published by Bituminous Coal Research, Inc.

This nontechnical booklet pictures a number of representative jet installations in which overfire air is either induced by steam jets or is supplied by motor driven blowers. The pictorial case histories were selected to "portray the versatility of jet application to the various types of furnaces and firing methods existing throughout the country".

Copies are available from BCR headquarters, 912 Oliver Bldg., Pittsburgh 22, Pa.

Includes Many New Techniques in Text on Manufacturing Processes

The tremendous increase in production and production methods during the war has given industry a great number of new processes and improvements. The revised second edition of the text, Manufacturing Processes, by M. L. Begeman, professor of mechanical engineering and superintendent of engineering shop laboratories, University of Texas, takes account of many of the new processes.

Principal changes in this edition are new chapters on special casting methods, powder metallurgy, and hot and cold forming of metals. The chapter on plastic molding has been rewritten as has much of the material on welding and allied processes. All chapters have some new material, particularly in regard to newly designed machines and the tools they use.

Inasmuch as this 626 page book describes foundry practice, pattern work, metal casting, plastic molding, heat treatment of steel, welding, forming of metals, and

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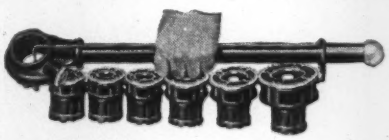

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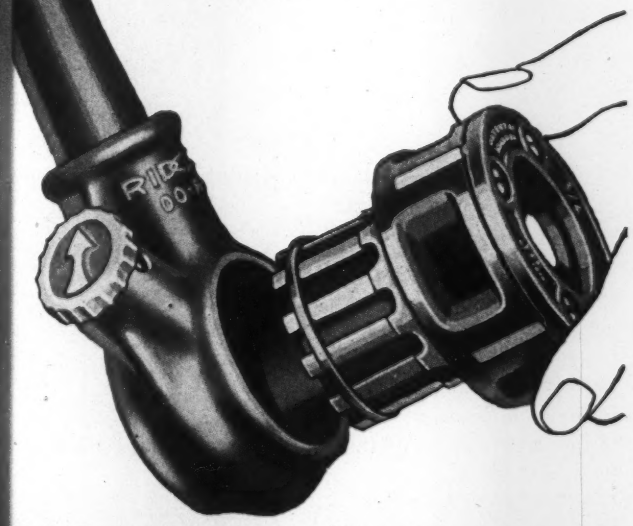

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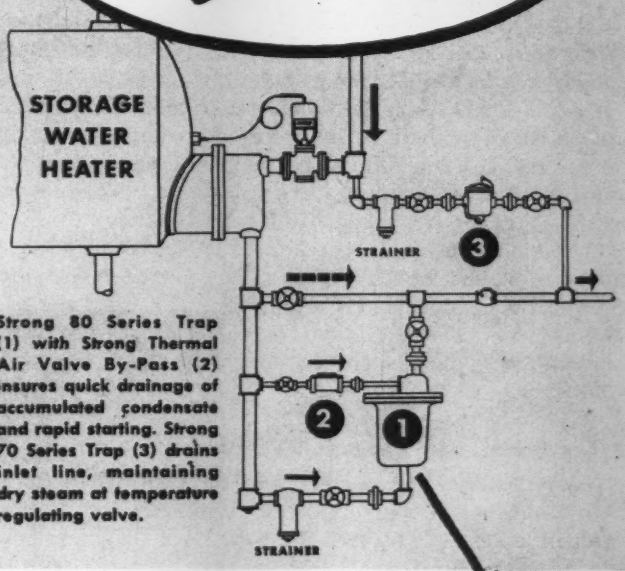

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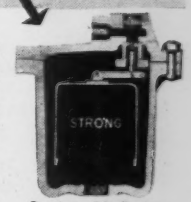

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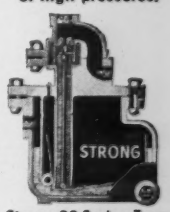

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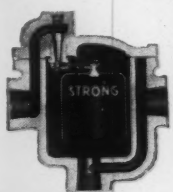

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virtually all types of machine tools, it is a comprehensive survey of industrial processes rather than a detailed handbook on any particular technique.

Published by John Wiley & Sons, Inc., 440 4th Ave., New York City, it is clothbound and priced at $5.00 in this country, $6.00 in Canada.

New Refrigeration Data Sheet Covers Ammonia Machines

Procedure in placing ammonia refrigeration machines into operation is the subject of a completely revised application data section published by the American Society of Refrigerating Engineers.

Known as AD 19-R, the brochure includes information on the basic principles of ammonia compressors, the mechanical refrigeration cycle, general erecting instructions, testing the system, starting and stopping a compressor, purging the system, and maintenance hints.

These subjects and others are discussed by several members of the ASRE technical committee B-1, under the chairmanship of J. R. Chamberlain, assistant chief engineer, York Corp. Copies may be obtained from ASRE headquarters, 40 W. 40th St., New York 18, N. Y., for 35 cents each.

Other Books and Reports Received

The Industrial Environment and Its Control, by J. M. DallaValle, consulting engineer. Published by Pitman Publishing Corp., 2 W. 45th St., New York City, and containing 240 pages, this clothbound text is priced at $4.50. It deals with engineering methods for the control of health hazards in factories and includes details on dusts, fumes, vapors, and gases, together with psychrometry, thermal environment, the effect and control of noise and vibration, and exhaust ventilation systems.

Elementary Thermodynamics, by V. M. Faires, professor of mechanical engineering, Agricultural and Mechanical College of Texas. Published by the Macmillan Co., 60 Fifth Ave., New York City, the book is clothbound, contains 268 + xii pages (6 x 9¼ in.), and is priced at $4.40. This 1948 revised edition presents a short coverage of the subject, made short by the omission of topics rather than by shortening explanations. Subjects include the general energy equation, characteristics and equations for perfect gases, reversible nonflow processes of gases, the Carnot and Ericsson cycles, internal combustion cycles, compression and expansion of air, liquids and vapors, vapor cycles, refrigeration, flow in nozzles, and mixtures.

Micromeritics—The Technology of Fine Particles (second edition), by J. M. DallaValle, consulting engineer. Published by Pitman Publishing Corp., 2 W. 45th St., New York City, it is a 555 (6 x 9 in.) page text, clothbound, and priced at $8.50. Particle measurement, size distribution, packing arrangements, physical properties, and industrial applications are discussed. The original edition has been thoroughly revised and new chapters have been added dealing with the behavior and diffusion of particles, surface phenomena, smoke and dust clouds, and the theory of sampling. In addition, new material has been added to almost all chapters and the references have been brought up to date.

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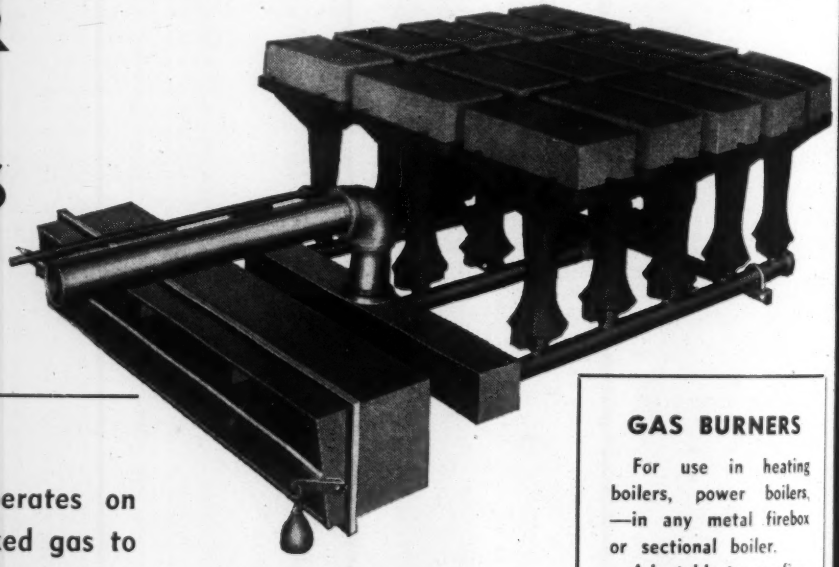

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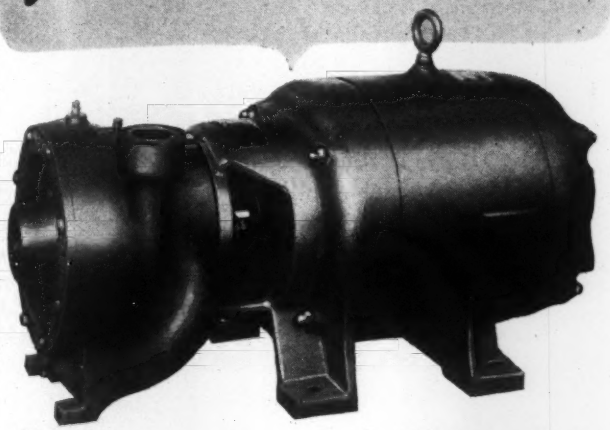

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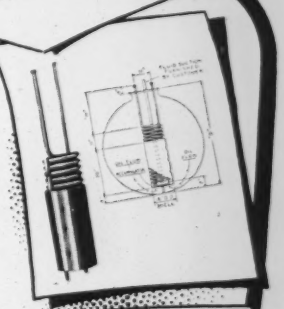

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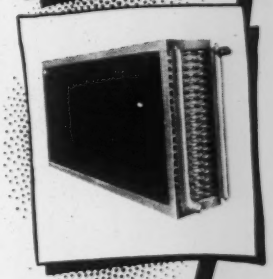

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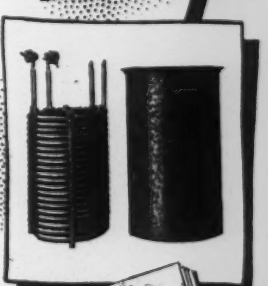

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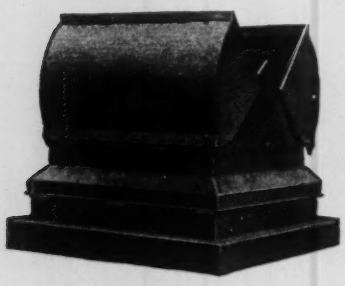

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MEETINGS & CONVENTIONS

Stoker Manufacturers to Meet in June

The Stoker Manufacturers' Association, 307 N. Michigan Ave., Chicago 1, Ill., has announced that its 1948 annual meeting will be held at the Greenbrier hotel, White Sulphur Springs, W. Va., June 17 through 19. According to the announcement, it is not expected that a general membership meeting will be held before this event.

Many Technical Sessions to Feature ASTM Annual Meeting

Some 20 technical sessions, where a large number of technical papers and reports in the field of materials will be given, and over 300 committee meetings will feature the 1948 annual meeting of the American Society for Testing Materials, 1916 Race St., Philadelphia. Throughout the meeting, to be held at the Book-Cadillac hotel, Detroit, June 21 to 25, the society's 8th Exhibit of Testing Apparatus and Related Equipment will be in progress. The Edgar Marburg Lecture is to be delivered, June 24, by Dr. Paul Aebersold, chief of the isotopes division, Atomic Energy Commission, Oak Ridge, Tenn.

Housing Officials to See Exhibit of Building and Maintenance Products

The Olympic hotel, Seattle, will be the scene of the Third Annual Exhibit of Building and Maintenance Products which will be conducted in connection with the 15th annual meeting of the National Association of Housing Officials. Scheduled for October 13 to 16, the meeting and exhibit are expected to attract many executive directors, nonsalaried commissioners, engineers, maintenance superintendents, architects, and other management personnel connected with permanent public housing. Association headquarters is at 1313 E. 60th St., Chicago 37, Ill.

AWS Members Urged to Make Annual Meeting Reservations

The 1948 annual meeting of the American Welding Society, 33 W. 39th St., New York City, will be held at the Bellevue-Stratford hotel, Philadelphia, October 24 to 29. Because this meeting will convene during the National Metal Congress and Exposition, a large demand for hotel accommodations is expected, and society secretary, M. M. Kelly, has forwarded hotel reservation cards to all members with the request that they be filled out and returned to the Bellevue-Stratford. This hotel will fill its rooms first, in the order in which reservations are received, and will then make reservations through the nearby Sylvania, and Walton hotels, owned by the same financial interests.

Previously Announced Meetings and Conventions

Second Engineering Progress Show, May 11 to 16, Franklin Hall, Franklin Institute of Pennsylvania, Philadelphia—sponsored by the junior members of the Engineers

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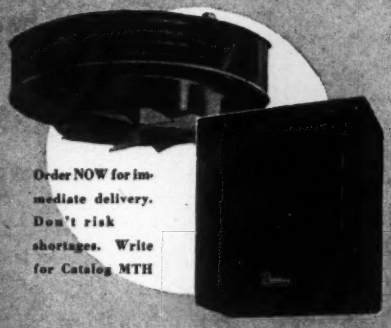

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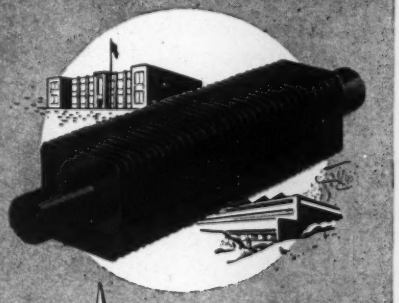

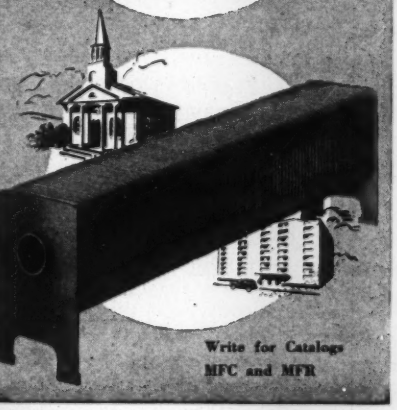

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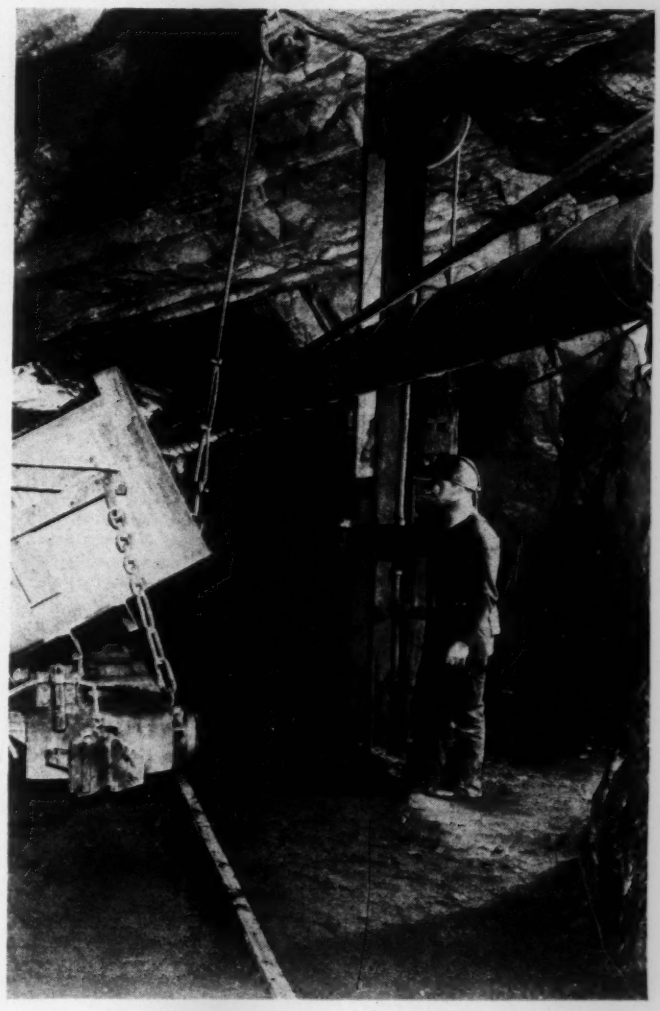

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Previously Announced Meetings and Conventions (Cont.)

Club of Philadelphia and the Franklin Institute of the State of Pennsylvania.

Scientific and industrial exhibits will be on display and prominent engineers will speak at the evening sessions. Among the speakers will be E. G. Bailey, president, American Society of Mechanical Engineers and vice president, Babcock & Wilcox Co. and T. P. Simpson, director of research, Socony Vacuum Oil Co. Additional information may be obtained from the Engineering Progress Show, 1317 Spruce St., Philadelphia 7, Pa.

National District Heating Association, 827 N. Euclid Ave., Pittsburgh 6, Pa.—39th annual meeting, May 18 to 21, Hotel Statler, St. Louis, Mo.

According to the condensed program released by Secretary J. F. Collins, Jr., the technical sessions will get under way the afternoon of Tuesday, May 18, with the reports of the commercial relation committee and the rates and regulations committee. Sales developments, together with meters and accessories, will be the subject of the following day's reports, and the morning of Thursday, May 20, will be devoted to reports from the research and steam station engineering committees. The meeting will be concluded Friday morning with the distribution committee report.

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—35th annual spring meeting, May 31 to June 2, New Ocean House, Swampscott, Mass.

Technical papers, scheduled for three morning sessions, will deal with recent developments in heat transfer techniques, a description of the "sniffer" type refrigerant leak detector, and a low temperature installation.

Heating, Piping, and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York City—59th annual convention, June 1 to 5, Hotel William Penn, Pittsburgh.

National Steam Specialty Club, an organization embracing about 65 manufacturers of engineering specialties—annual meeting, The Homestead, Hot Springs, Va., June 10 to 12. Secretary-treasurer is F. H. Jones, Schade Valve Mfg. Co., 2527 N. Bodine St., Philadelphia 33, Pa.

Third Annual Home and Building Exposition, June 10 to 20, Pan-Pacific Auditorium, Los Angeles—the show is owned by the Los Angeles chamber of commerce and 14 industry associations of southern California.

I-B-R Short Course in Heating, sponsored by the University of Illinois and the Institute of Boiler and Radiator Manufacturers. To be held at the university June 15 through 17, it is a three day short course for the study of hot water and steam heating systems. Address requests for information to H. C. Rountree, assistant director, Division University Extension, room 118A, Illini Hall, University of Illinois, Champaign, Ill.

Students will be split into two groups, beginners and advanced, and will attend separate classes for individual hot water and steam heating problems. Lectures for all

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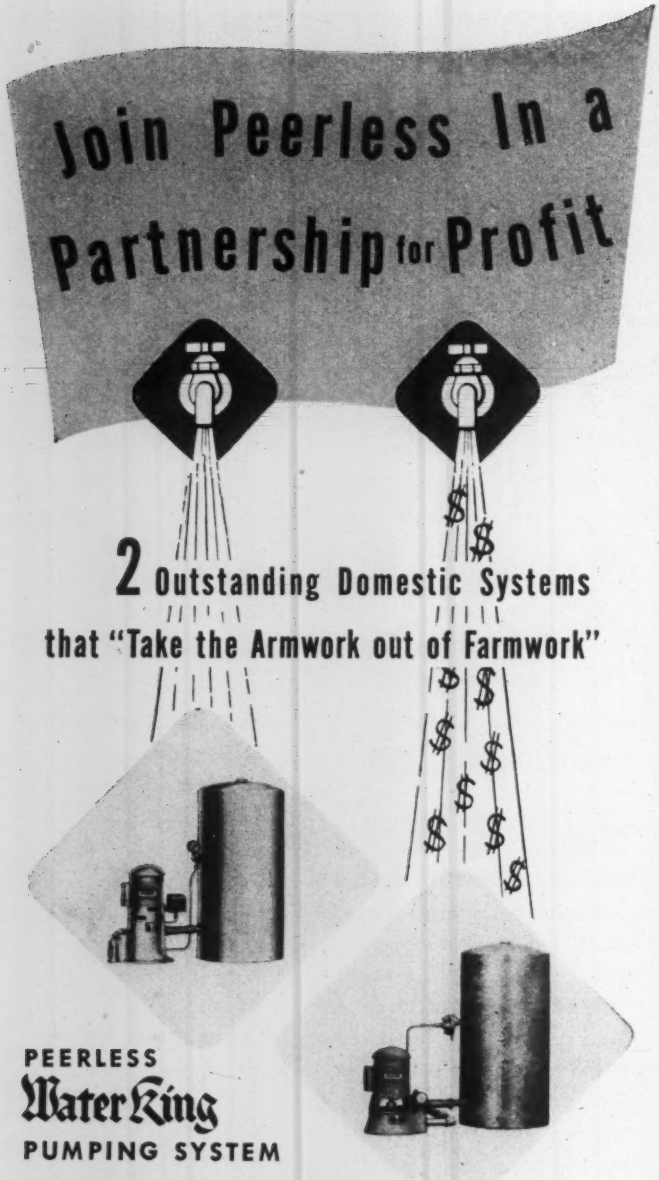

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Previously Announced Meetings and Conventions (Cont.)

students will be given on heat loss calculations, blue print reading, fuels and combustion, panel heating problems, and baseboard radiation.

R. E. Ferry, general manager of I-B-R, will address the group at a dinner meeting June 16. L. N. Hunter, vice president and director, National Radiator Co., will also speak to the group.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City—1948 semi-annual meeting, June 21 to 23, Mount Washington hotel, Bretton Woods, N. H.

National Warm Air Heating and Air Conditioning Association, 145 Public Sq., Cleveland—midyear convention, June 29-30, Edgewater Beach hotel, Chicago. Midyear convention of the National Heating Wholesalers Association, 2130 Keith Bldg., Cleveland 15, will be held at the Edgewater Beach on June 28.

National Catholic Building Convention and Exposition, Inc., 185 N. Wabash Ave., Chicago, Ill.—building convention and exposition, June 30, July 1 to 3, Stevens hotel, Chicago.

The 2nd International Store Modernization Show, July 6 to 10, Grand Central Palace, New York City. Invitations for admission can be obtained from exhibitors or from the Store Modernization Show, 40 E. 49th St., New York 17, N. Y.

The Third National Instrument Conference and Exhibit—sponsored by the Instrument Society of America, 1117 Wolfendale St., Pittsburgh 22, Pa. To be held September 13 to 17, Philadelphia Convention Hall.

American Gas Association, 420 Lexington Ave., New York City—1948 convention, the week of October 4. Atlantic City.

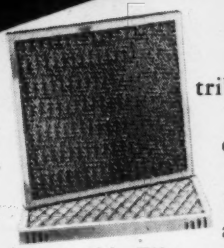
American Chemical Society, Chicago section, 1513 S. Wabash Ave., Chicago 5—Fifth National Chemical Exposition, October 12 through 16, Chicago Coliseum.

American Society of Refrigerating Engineers, 40 W. 40th St., New York City—1948 annual meeting, December 5 to 8, Hotel Statler, Washington, D. C.

Pan-American Engineering Congress, to be held late in 1948 or in 1949, South America—further information to be released by the Engineers Joint Council Committee on International Relations, 29 W. 39th St., New York City.

Ninth International Heating, Ventilating, and Air Conditioning Exposition, January 24 to 28, 1949, International Amphitheatre, Chicago—under the auspices of the American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York City.

Aircor Air Filter Protection Means Effective Dust Collection



Aircor's expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.

Aircor Air Filters available in standard 1″ and 2″ thickness with filters for industrial and special applications in 2″ and 4″ thickness.

Holding frames (for V type or straight banks) are made for all type filters.

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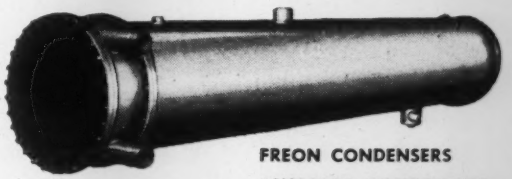
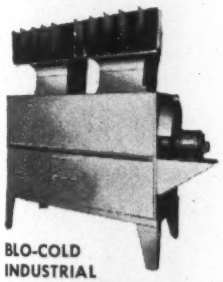


FREON CONDENSERS
AMMONIA CONDENSERS



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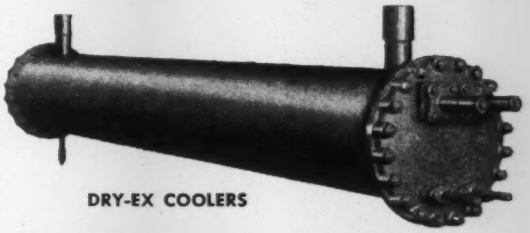

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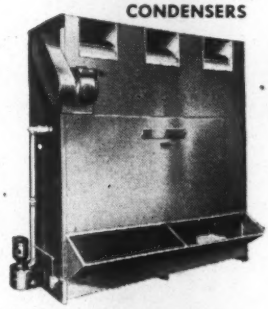
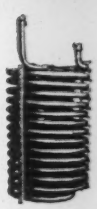
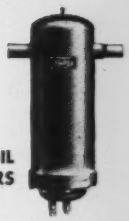


SHELL AND COIL CONDENSERS

SHELL AND TUBE CONDENSERS



PIPE COILS



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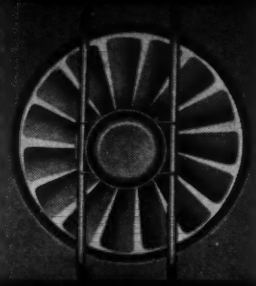
NO matter what your need for quiet, variable speed, attractively designed fans, you'll find the answer in a Peerless Electric design.

A combination of specially engineered capacitor motors and perfectly balanced extra wide blades produces extremely quiet operation. Motors are totally enclosed and permit installation in either a vertical or horizontal position.

These fans are supplied in single-speed, two-speed or three-speed operation and finished in gray. Recommended for stores, restaurants, hotels, offices and similar installations where quietness of operation and attractive appearance are prime requisites. Write for descriptive folders.



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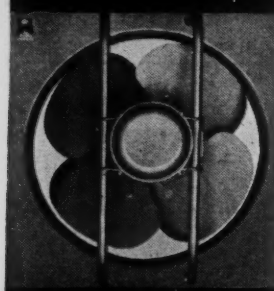

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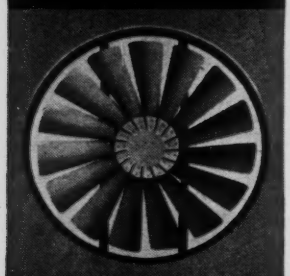

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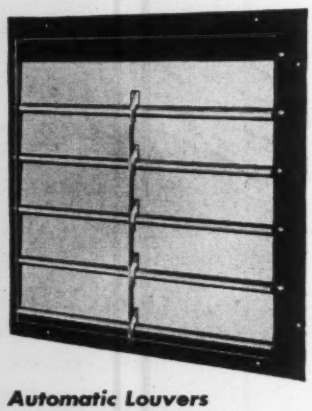

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Peerless Electric automatic louvers are designed especially for use with propeller fans. When the fan starts, the air stream instantly opens the louvers, which close by gravity when the fan stops. Completely weatherstripped around the inner edge of the frame. Built of high grade aluminum. Sizes from 10 to 48 inches.

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 191. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

Blast Coils and Heaters

No. 6835—Super Radiator Corp., 652 Stinson Blvd., Minneapolis, Minn., has issued a new bulletin (No. 48) on its line of blast coils and heaters. The coils are built in five types, have copper tubes and fins, and incorporate one piece cast headers. Design and construction features, dimensions, and performance data are included along with pertinent information in regard to piping details.

Condensation Pump

No. 6836—Bulletin No. 14-A, released by Skidmore Corp., St. Joseph, Mich., covers the type HS condensation pump unit which consists of a horizontal, centrifugal pump and motor together with receiver and float switch, all completely assembled and mounted on a flat base. In addition to describing design and construction features, the bulletin provides information on capacities, dimensions, discharge pressures, and motor sizes.

Condensate Return System

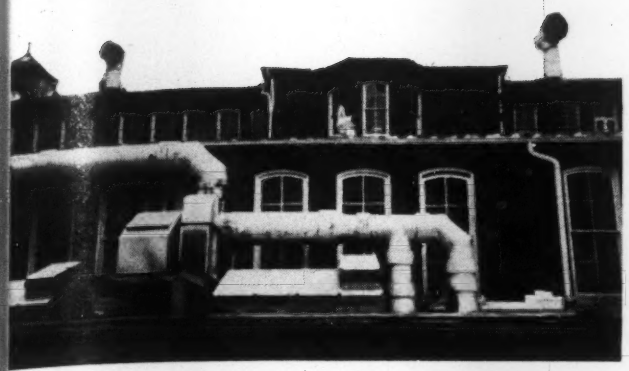
No. 6837—Cochrane Corp., 17th St. & Allegheny Ave., Philadelphia 32, Pa., has announced the publication of an expanded 20 page bulletin (No. 3250) on its C-B system which is designed to return high pressure, high temperature condensate to boilers. New material has been added on turbulent vs. laminar steam flow and the effects of air and condensate films on heat exchange characteristics. Improved equipment for the positive removal and drainage of condensate is also described for the first time.

Control of Textile Mill Air Conditioning

No. 6838—New Techniques in Pneumatic Controls for Textile Mill Air Conditioning, by A. H. Koch, is the title of the feature article in the Vol. 3, No. 2 issue of Instrumentation, the house organ published by Brown Instrument Co., Div. of Minneapolis-Honeywell Regulator Co., 4534 Wayne Ave., Philadelphia 44, Pa. The advantages of dew point temperature control for air washers, the use of averaging bulbs on dew point controllers, and the need for a controller incorporating a wide proportional band and automatic reset are discussed. Also mentioned is a means for insuring that both outside and return air dampers will always assume the same relative position for any given air pressure on the damper motor.

Dehumidification Equipment

No. 6839—A new eight page folder on the "Kathabar" system of dehumidification describes the principles upon which the system operates, explains how it is applied, and briefly covers the equipment offered by Surface Combustion Corp., Toledo 1, Ohio.



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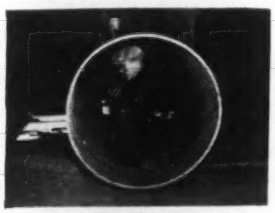
VENTING PROBLEMS

• Plant engineers in many industries are finding the answer to tough venting problems—and high venting costs—in Transite Industrial Vent Pipe.



EASILY WORKED: Transite can be cut and drilled on the job.

The reason: this asbestos-cement product is highly resistant to many corrosive fumes, vapors, dusts and gases. Its ability to stand up under corrosive conditions cuts frequency of replacements, results in important economies in plant maintenance.

In addition, Transite Industrial Vent Pipe has a smooth inner surface that assures minimum frictional resistance—means economical operation.

This pipe has many other practical advantages. Relatively light in weight, it is easily installed. It can be cut and drilled on the job. Rustproof, it needs no painting whether used indoors or out.

ADAPTABLE: A complete line of Transite fittings meets a wide range of job requirements.

Transite Industrial Vent Pipe is made in a range of sizes up to 36" in diameter and is readily adaptable for use as vents, ducts and stacks. A full line of Transite fittings provides a venting system which is corrosion resistant throughout.

For further information write Johns-Manville, Box 290, New York 16, N. Y. Ask for Data Sheet Series DS-336.

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3 DEPENDABLE SERVANTS of AIR CONDITIONING and HEATING

ALL MADE TO FUNCTION IN HARMONY BY THE SAME MANUFACTURER

FIG. R 5506

This Single-Shaft PUMP and MOTOR UNIT is an all ball bearing unit with none of the bearings in the casing. Bearings are sealed against dirt and require only one lubrication a year. Sizes with capacities from 10 to 750 G.P.M. Made in 2 types. Type R.U. with packed Stuffing Box for Cooling Tower service. Type RY with leak proof Mechanical Seal for Hot or Chilled Water Circulating.

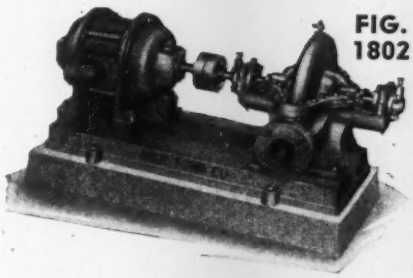

FIG. 1802

High efficiency, Double Suction Pump with Horizontally Split Case. Performs the same services as Fig. R 5506 Pump and is used where greater volume is required. Capacities from 50 to 1200 G.P.M. and heads to 250 ft. Also designed for Booster Service.

For the heating system this Vertical Underground Condensate pump and receiver is supplied either Single or in Duplex as shown. Receivers may be Cast Iron or Steel. We also make the Horizontal type for Low Pressure, known as TVC 300 and SRC 450.

FIG. NRG 2001

Bulletins Are Available From Your Jobber or Our Factory

Fig. R5506, see Bulletin R5500

Fig. 1802, see Bulletin A1800A

Fig. 2001, see Bulletin NRG200A

Horizontal Condensate Pumps —see Bulletins TR100B and RC500A

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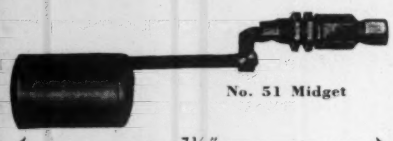
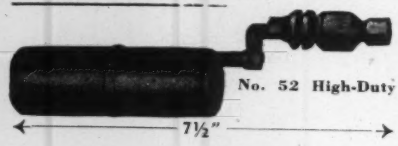


No. 51 Midget

7⅛"

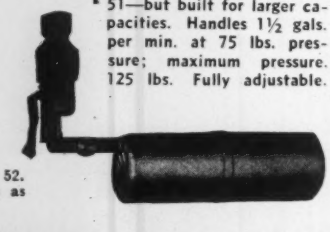
Accurately maintains water line as low as 1" deep—thumb screw adjustment. Entire valve made of non-ferrous metals. Easy to install by drilling one hole. Capacity one quart per min. at 50 lbs. pressure; maximum pressure, 75 lbs.



No. 52 High-Duty

7½"

Same general design as No. 51—but built for larger capacities. Handles 1½ gals. per min. at 75 lbs. pressure; maximum pressure. 125 lbs. Fully adjustable.



No. 53 High-Duty Bracket Valve

Same construction and capacities as No. 52. Only difference is vertical mounting of valve as shown at right. Overall length 5 9/16".

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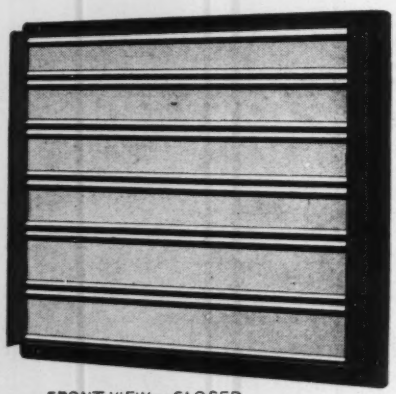
AUTOMATIC HUMIDIFIERS FOR ALL TYPES OF HEATING SYSTEMS

AIR-FLO MODEL A-555

AUTOMATIC SHUTTER

WEATHER-SEALED

leads the field in features!



FRONT VIEW--CLOSED

There is every reason why you should use AIR-FLO shutters on your jobs. New heavy reinforcement strip adds strength and long life to the louvers, assures quiet operation and perfect counterbalance, prevents rattling. Aluminum louvers open fully, permitting capacity fan operation. Deep shroud protects shutter from high winds. Tie-rod, brackets and bearings inside frame, not exposed to weather. Special finish resists corrosion. Many other features. Write for illustrated catalog 42-D of the complete AIR-FLO line.

AIR CONDITIONING PRODUCTS CO.

2340 W. LAFAYETTE BLVD. DETROIT 16, MICH.

Drafting Templates

No. 6840—Rapidesign, Inc., Box 592, Glendale, Calif., has issued a new catalog (No. 48) on its line of drafting templates designed to reduce the time required to draw commonly used symbols and figures. Some of the templates which are described and illustrated are used for drawing ellipses, circles, hexagonal cap screws, and squares, together with laboratory instrument, welding, electrical, piping, office plan, and store layout symbols.

Exhaust Fans

No. 6841—Direct drive, bucket type exhaust fans designed for ventilating jobs in commercial establishments are covered in Bulletin 107A issued by Martin Fan & Blower Co., 4632 W. 21st Pl., Chicago 50, Ill. The bucket type construction of the fan blade is said to be an outstanding feature. Fans and louvers are furnished as one complete unit, and free air deliveries range from 850 to 9000 cfm.

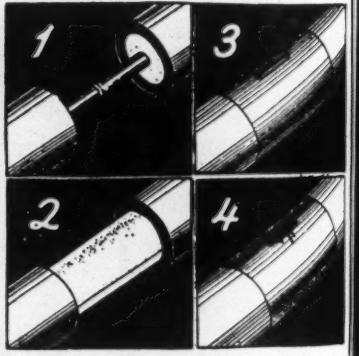
Forged Steel Valves

No. 6842—Ohio Injector Co., Wadsworth, Ohio, has released a new 16 page catalog on its line of forged steel valves, including the 600 psi gate, globe, angle, and check valves. Also covered are the design, construction, materials, ratings, and markings for other valves in the line.

Fractional Horsepower Motors

No. 6843—The line of fractional horsepower motors (1/6, 1/4, 1/3, and 1/2 hp) offered by Torq Electric Corp.

Positive Protection



4 Simple Steps

1. Field joint ready for inspection. 2. Joint covered with standard pipe insulation. 3. Durant joint casing in place ready for asphalt. 4. Asphalt poured in slot making a perfect seal.

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For all your underground and exposed piping jobs you'll like DURANT Pre-Sealed Insulated Pipe. It is waterproof . . . reduces installation costs to a minimum . . . eliminates electrolysis and corrosion . . . requires very little trenching and field work . . . avoids extra cost of waste and breakage . . . comes to you ready to install. In short, D.I.P. is the *perfect pipe* for this type of job. Investgate D.I.P.! Write for details today.

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Welding neck, slip-on, socket, threaded, lap joint, blind, hillside, boiler spuds . . . the Phoenix line includes all these types. They're drop forged of mild steel perfectly suited to machining and welding and they meet ASA requirements and ASME and ASTM specifications in every case. The Phoenix Flange Catalog shows the full line. Request your copy today.

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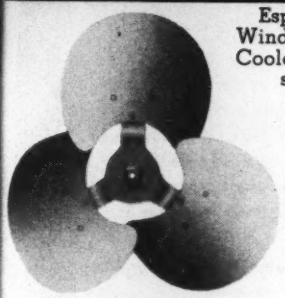

Especially designed for use in Window Box Fans • Evaporating Coolers • Refrigerators — wherever space-saving is a factor

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OFFSET PROPS

These bright aluminum blades are precision-built, static-balanced and insulated from the spider and hub to guarantee accuracy and smooth, efficient performance.

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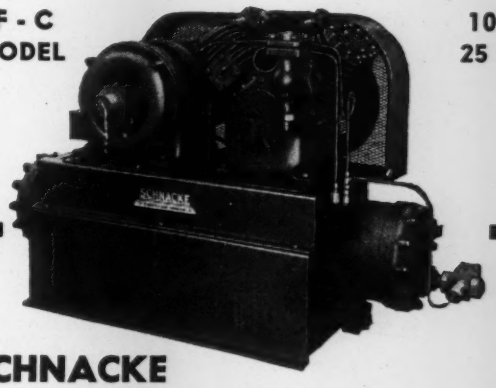
Available in 16″ to 24″ sizes and in 18° and 23° pitch. Others 10″ to 54″—11° to 34° pitch. For complete details, write for Bulletin No. 2208. Meier Electric & Machine Co., Inc., 3525 E. Washington Street, Indianapolis 7, Indiana.

There's a Meier Nu-air Precision Prop for every type of ventilating equipment.

Produced under license from the Torrington Mfg. Co. and General Electric Co.

F-C MODEL 10 TO 25 H.P.



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For Air Conditioning and Refrigeration

SCHNACKE Compressor has replaceable, refrigerant-cooled steel cylinder sleeves, balanced forged crankshaft, sealed crankcase, complete pressure lubrication, and many other advanced features.

Condenser is ASME approved, fin tube, cleanable type, mounted in sturdy base. Water control valve and pressure control installed. T-C Models 5 to 15 H.P. available. Models less condenser, from 5 to 50 H.P.

Our new foundry now makes deliveries on most models possible in one to two weeks.

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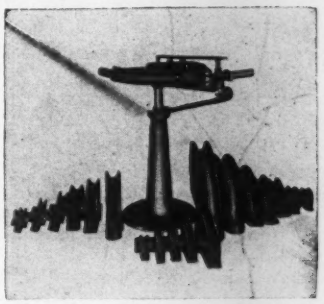
PIPE BENDING MACHINES . . .

for fast, dependable bends

Radiant HEAT Pipe Bending is simple, accurate with good equipment . . . hand or motor-powered machines available . . . up to 8″ capacities.



The Hand-powered "American" A-30

Bends ½″ to 2″ standard pipe sizes to a radius of 5 to 1, up to 180°. Special radii within these sizes supplied on request. Usual radiant heat bends for 1¼″ at 6″ & 9″ radii can be supplied. Special radius supplied on request.

- Average bend takes only 60 seconds!
- Versatile—bends cold pipe, conduit and tube, copper and brass I.P.S. without crimping.
- 12,000 in use all over the world.

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KEY Company

1006 Interstate St., Bedford, Ohio, is described and illustrated in a new bulletin. "High load capacity" capacitor start, and polyphase motors are covered and the new "Syncrosnap" starting switch and "Temprotex" thermostatic overload protector are described. Motors are fan cooled, dripproof, and are said to have triple protected windings.

Gas Burners

No. 6844—Venturi type gas burners consisting of groups of multiport refractory tile burners are covered in a six page bulletin issued by Haney Gas Burner and Engineers, 909 S. Myrtle Ave., Monrovia, Calif. Both vertical and horizontal types for residential, commercial, and industrial applications are described and illustrated.

Gasoline Engine

No. 6845—The model U-100 "Ultimotor" is a gasoline engine designed to develop 2.4 hp at 3000 rpm. According to the manufacturer, Uebelhoer Bros., Inc., 848 Kensington Ave., Buffalo 15, N. Y., it is suitable for use with saws, pumps, hoists, sprayers, compressors, small generating plants, and similar equipment. This four cycle, lightweight unit is described and illustrated in a new bulletin which includes dimensional and mechanical specifications.

Industrial Steam Traps

No. 6846—The new 12 page bulletin (No. 1047) issued by W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa., features industrial steam traps equipped with bel-

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The World Over
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The tradition of honest workmanship has been passed on from generation to generation. And the Brownell name on boiler-room equipment grows in significance with the passing years.

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Write Eclipse-Pioneer for information.

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TETERBORO, NEW JERSEY
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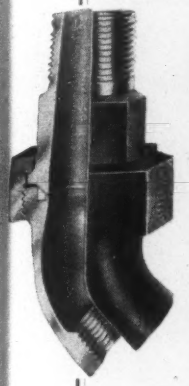
You can depend on the
RECESSED BRASS SEAT
in JEFFERSON
UNIONS



The recessed brass seat is an important feature of Jefferson Specialty Unions. It's incorporated in the versatile 45 degree male and female union ell shown at left; once this union is installed you know there won't be any leaks because the brass seat seals TIGHT! It's impossible to dislodge it, too, because it's located away from the runway of the fitting . . . no chance of pipe ends unseating it. Install Jefferson Unions at the start and make sure your jobs are secure against leaks and shutdowns. Please write for more detailed information.

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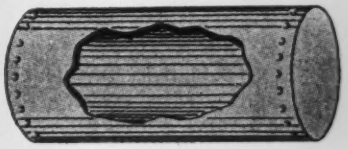

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CHEMICALLY STEAM & WATER SYSTEMS. Eliminate sludge and foreign matter from your entire plant safely and economically. We clean and restore to original operating efficiency CHEMICALLY such equipment as: TURBINES — CONDENSERS — STEAM FEED LINES — CONDENSATE RETURNS —WATER HEATERS—STEAM KETTLES—COOLING AND HEATING COILS — PREHEATERS — HEAT EXCHANGERS — EVAPORATORS — TRAPS OF ALL KINDS — ETC.

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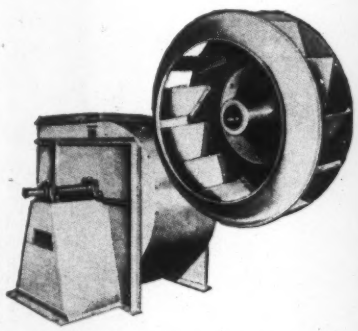

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DESIGN 4
• AIR CONDITIONING •
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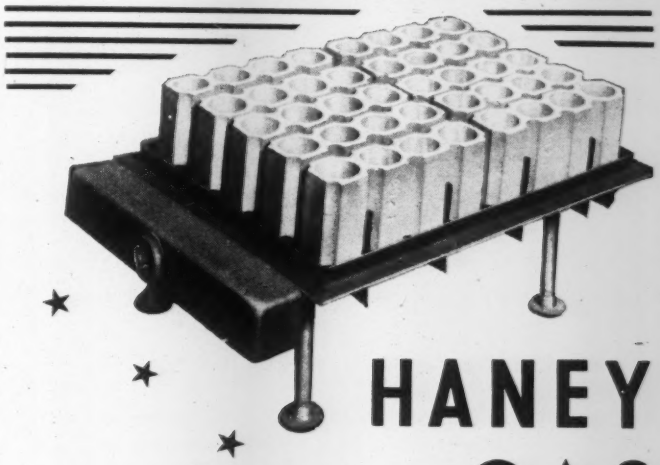

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Haney Venturi Gas Burners are the answer to all your heating installations whether commercial, domestic, or industrial. The vertical type illustrated will afford economical, even, dependable heat with remarkable freedom from maintenance troubles. It's shipped completely assembled, ready for installation and is available for mixed, natural or LP gases.

We'll be glad to send more information on request . . . please write!

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lows of bronze, monel, or stainless steel and bodies in bronze, cast iron, and cast steel construction. The traps described are available in sizes from ¼ to 2 in. for pressures from vacuum to 300 psi. In addition to capacity tables and dimensions, recommended piping diagrams, typical applications, and data on the selection of these traps for various types of equipment are included.

Magnesia Insulation

No. 6847—The Vol. 2, No. 2 issue of the house organ published by the Magnesia Insulation Manufacturers' Association, 1317 F St., N.W., Washington 4, D. C., features a brief discussion of some techniques in applying 85 per cent magnesia insulation to shipboard equipment. Also included is an article describing applications of this insulation in the new Indianapolis penicillin plant of Eli Lilly & Co.

Perforated Ceiling Panels

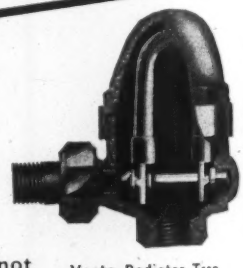
No. 6848—Steel and aluminum perforated ceiling panels designed to incorporate air distribution outlets, fluorescent lighting, and noise reduction are briefly covered in three data sheets released by Simplex Ceiling Co., 552 W. 52nd St., New York 19, N. Y. Another application stressed by the manufacturer is in connection with radiant panel heating as the use of these units provides access to the pipe coils.

Pipe Insulation and Priming Paints to Check Moisture Infiltration

No. 6849—The Vol. 18, No. 1 issue of the Insulator, house organ of Armstrong Cork Co., Lancaster, Pa., in-

HAINES TRAPS
Cannot become air bound

Haines Float and Thermostatic traps are designed to perform efficiently and safely under the most exacting conditions. They're made for low pressure jobs up to 20 lbs. in the ¾" size and 30 lbs. in the 1" and 1¼" sizes. They cannot become air bound, and the Haines underslung valve principle means safety at all times . . . no danger of building up a pressure. The famous Bourdon Thermostatic tube is used on all Haines traps . . . and is the strongest ever built into a steam trap. You can examine them under pressure, too . . . simply remove the cover and all working parts are before you. Please write now for more information.


Vento Radiator Trap

F & T Trap

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You Know at a Glance!

Red Indicator is easily readable from any direction

- NO SPRINGS
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No guessing with AT-A-GLANCE. You know too, that they are guaranteed leak-proof — are "tailor-made" to fit all tank sizes and shapes — are sturdily built to withstand excessive pressure, and are fully Underwriter listed.

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GREEN BAY • WISCONSIN

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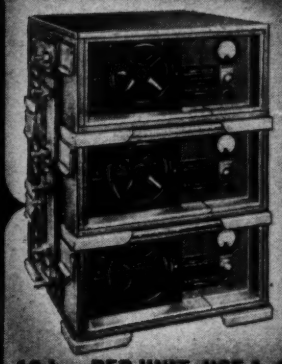

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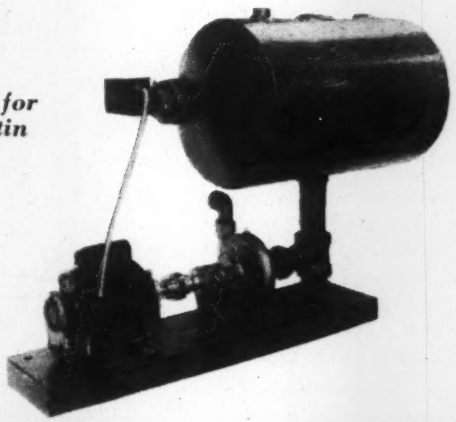

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GASKET REPLACEMENT

The only tool that takes the guesswork out of replacing gaskets, regardless of location. Flanges are parted quickly and held in perfect alignment without damage to faces . . . shock and jarring of pipe lines are eliminated . . . there is no danger from flying wedges . . . no sparks caused by hammer blows. FLANGE-JACKS eliminate costly shutdowns, make possible fast, economical repairs in hard-to-get-at locations, offer maximum safety.

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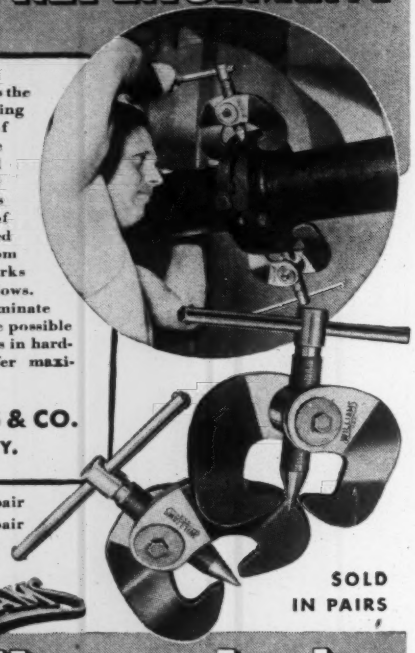

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See your distributor for trade discounts

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Underground Pipe Conduit

Better and dryer insulation assures higher efficiency.

PERMANENT construction — no reduction in efficiency year after year—assures lower ultimate cost.

Besides, this remarkable underground steam pipe conduit is actually *competitive* in FIRST cost. Tell us your problem in full detail and we will quote.

Sold and installed by Johns-Manville Construction Units in all principal cities.

ASK for BULLETIN 381 which completely illustrates and describes THERM-O-TILE

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cludes a discussion on whether or not hot pipe flanges should be insulated or left bare. Economic and maintenance considerations are covered and a typical problem is worked out. Another article describes the use of 7 in. of cork lagging over a base of standard thickness 85 percent magnesia pipe covering on a line designed to handle temperatures from −75 F to 200 F. Also included is an article on priming paints to check moisture infiltration in cold storage room insulation. Advantages of the company's paint are covered.

Preplated Alloy Metals for Decorative Trim, Functional Use

No. 6850—The line of preplated alloy metals which is offered by American Nickeloid Co., Peru, Ill., for functional use and decorative trim, is described in Booklet G. Profusely illustrated with photographs showing numerous applications, the booklet also lists physical properties, sheet sizes, tempers, and gages of the sheets, coils, and round edge flat wire offered. Product designers and executives may obtain copies of the bulletin by sending requests to the manufacturer on company letterheads.

Propeller Fans

No. 6851—A new 32 page catalog (No. X6049) describes in detail the complete line of propeller type fans offered by Emerson Electric Mfg. Co., St. Louis 21, Mo. Design and construction features are covered and performance data are included on desk fans, stand fans, air circulators, ceiling fans, and various types of exhaust fans.

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The OIL BURNER with an INTERNATIONAL REPUTATION

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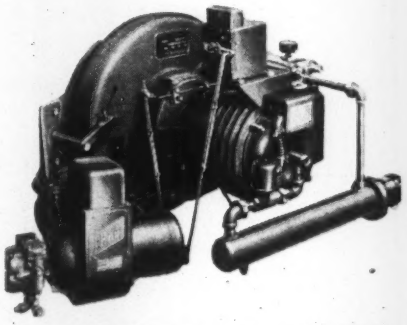

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- Fully automatic heavy oil burner, Type ARJP-144.
- Straight electric ignition with diesel oil burner, eliminating need for gas
- Available in ten sizes, 16 to 700 boiler H.P.
- Years of continuous service throughout the world attest to the reliability of this Ray Champion

There's a Ray Burner for Every Heating Purpose

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Spraying Systems SPRAY NOZZLES consistently provide accuracy of spray that means better operation and lower cost for you. Whatever you specify in terms of pressure, volume, spray pattern, distribution, impact, and atomization can be duplicated accurately with a Spraying Systems Spray Nozzle. Write for the facts . . . ask for Catalog 22, a reference manual that lists spray characteristics for thousands of spray nozzle types and sizes.

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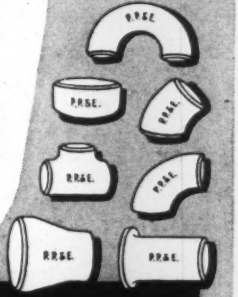
with P. P. & E. *Stainless* STEEL WELDING FITTINGS

P. P. & E. stainless steel welding fittings reduce the cost of installing a stainless piping system—because any system can be constructed with them simply by straight cutting of tubes to desired lengths and plain butt-welding. Complicated "angle" cutting and fitting is eliminated; fewer welds are needed; and faster, uniformly sound welds are assured. A clean, lastingly efficient, trouble-free system is the result since pockets and sharp corners that cause erosion, product accumulation, and pressure drop are eliminated.

These fittings are available in Stainless Types 304, 316, and 347 to match piping and tubing of various wall thicknesses in sizes from ¾" through 12". Send for Catalog S-309 which gives complete specifications and list prices of the world's most complete line of stainless welding fittings.



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PITTSBURGH PIPING and EQUIPMENT COMPANY

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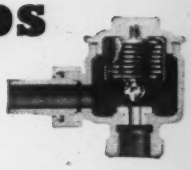
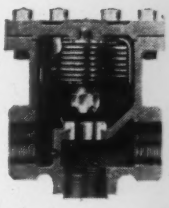
World's Largest Manufacturer of Stainless Steel Welding Fittings

Nicholson Simplicity Enables You to

STOP Adjusting Steam Traps

Nicholson traps require no adjustment or change of valve and seat from 0 to 225 lbs. This feature proves an exceptional trouble-saver in plants with many and varied trap applications. With these other 5 features, it accounts for the increasing standardization on Nicholson traps: 2 to 6 times average drainage capacity; operate on lowest temperature differential; no freeze-ups, air-binding, nor water-logging.





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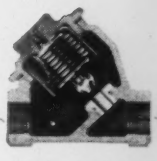
power, heat, process; size ¼" to 2"; steam press. to 225 lbs. Also weight and piston-operated traps for steam, air, gasoline; press. to 1500 lbs. Expansion steam traps for press. to 225 lbs.



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Valves ★ Traps ★ Steam Specialties

Bulletin 1047 is a valuable reference on advanced drainage methods. Or see Sweet's.

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